THE USE OF HOE-39866

AS A POTATO-TOP DESICCANT

by

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ABSTRACT

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Hoe-39866 [ammonium-(3-amino-3-carboxypropyl)methyl-phosphinate] provides good desiccation of potato haulms. In field studies with three cultivars (Kennebec, Sebago and Russet Burbank), Hoe-39866 gave desiccation results comparable to diquat (6,7-dihydrodipyrido[1,2-alpha : 2',1'-c] pyrazinediium ion). Emergence of seed pieces from plants of the three cultivars treated the previous year with Hoe-39866 (0.5 and 1.0 kg a.i./ha), was delayed. Yields from these plants were reduced for Kennebec and for Russet Burbank. Controlled environment studies confirmed the residual effect of desiccation with Hoe-39866 (0.5 and 1.0 kg a.i./ha) by reducing sprout growth after normal storage conditions of the three cultivars Kennebec, Russet Burbank and Sebago. Combination of low rates of Hoe-39866 and diquat resulted in good desiccation without affecting, after normal storage conditions, emergence sprout growth and yield of seed tubers. Sprout growth of tubers dipped in solution of Hoe-39866 at concentration equal to spray deposit (1.0 kg a.i./ha or 3333 ppmw) was reduced by 76%, indicating possible absorption of Hoe-39866 by the tubers. Basipetal movement of Hoe-39866 or of its metabolites was also demonstrated, suggesting that absorption of Hoe-39866 and/or translocation of the herbicide from top to tubers may be involved in the inhibition process.

RESUME

M. Sc. François Montambault Phytobiologie Malherbologie

L'UTILISATION DU HOE-39866 POUR LE DEFANAGE DES POMME DE TERRE

L' herbicide Hoe-39866 [ammonium-(3-amino-3-carboxypropyl)methyl-phosphinate] procure un défanage adéquat des plants de pommes de terre. Des études en plein champs faites sur trois cultivars (Kennebec, Sebago et Russet-Burbank), ont démontré que le Hoe-39866 procurait un défanage comparable à celui obtenu avec le diquat (6,7-dihydrodipyrido[1,2-alpha : 2',1'-c] pyrazinediium ion). Suite à la plantation de tubercules obtenus de plants de pommes de terre préalablement défanés par le Hoe-39866, un retard dans la levée des plantules à été noté. Le rendement de ces plants a été réduit chez les cultivars Kennebec et Russet-Burbank. Après des conditions d'entreposage normales, et sous environnement contrôlé, la réduction de la pousse des germes de tubercules des cultivars Kennebec Russet-Burbank et Sebago, a confirmé l'effet résiduel du Hoe-39866 utilisé à des taux de 0.5 et 1.0 kg i.a./ha. L'utilisation de taux réduits de Hoe-39866 combiné avec le diquat, a procuré un bon défanage sans toutefois affecté, après des conditions normales d'entreposage, les qualités régénératrices des tubercules. La pousse des germes de tubercules, préalablements plongés dans une solution de Hoe-39866 ayant une concentration égale à celle de la bouillie (1.0 kg i.a./ha), a été réduite de 76%; indiquant l'absorption possible du Hoe-39866 par les tubercules. Le mouvement basipète du Hoe-39866 ou de ses métabolites a aussi été démontré. La réduction du potentiel régénérateur des tubercules pourrait donc être causée par l'absorption du Hoe-39866 et/ou la translocation de cet herbicide du feuillage jusqu'au tubercule.

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INTRODUCTION

World production of potatoes (Solanum tuberosum) is nearly 300 million metric tonnes annually, making it the world's second most important food crop after cereals (Martin Leonard and Stamp, 1976). Countries leading in potato production are the Soviet Union, Poland, West Germany, the United States, East Germany, France and China (Martin *et al.* 1976). Canada is the world's second largest exporter of seed potato, supplying markets in the U.S.A., Europe, Africa, the Carribbean and South America (Rowberry and Howells, 1979). In Canada, most of the production occurs in the eastern half of the country (Rowberry and Howells, 1979) (Table 1.1). Much of Prince Edward Island's and New Brunswick's important production is exported as seed, the rest of it being processed or sold as table stock (Rowberry and Howells, 1979).

Potatoes are cool weather plants and are grown chiefly in cool climate; days of intermediate length, cool temperature and ample nitrogen favoring maximum tuberisation (Martin *et al.* 1976). Terman et al. (1952) reported that " under conditions of heavy fertilization and effective disease and insect control, potato plants usually remain alive in Maine, U.S.A., until killed by frost or other means. This characteristic along with the fact that cool moist conditions favor development of late blight led to the development of a new management practice (Martin *et al.* 1976)

Murphy (in Callbeck, 1949) reported " that where blight breaks out late in the season on potatoes which were previously healthy, and where it is believed the tubers are still free from infection, there are good indications that the safest course to follow is to remove the stalks and not to dig the crop until at least two weeks later ... It is believe that a better way would be to spray the plants with a poisonous chemical in order to reduce the danger of shaking down conidia from the leaves and disturbing the soil ". With subsequent research, this new technique of vine killing became a common practice around mid-century (Callbeck, 1949).

Table 1.1 Potato production in Canada, 1985.

Province	Potato production in thousands of CWT	% of total Canadian production	% of total Canadian seed production
Newfoundland	90	0.13	0.05
P. E. I.	17,616	26.37	61.44
Nova Scotia	798	1.19	0.15
New Brunswick	15,400	23.06	23.13
Québec	10,141	15.18	4.37
Ontario	7,660	11.47	1.22
Manitoba	7,505	11.24	3.51
Saskatchewan	598	0.90	0.44
Alberta	4,800	7.20	4.04
British Columbia	2,184	3.27	1.67

1.1 Advantages of vine desiccation

The main reasons for pre-harvest vine killing are: 1) to prevent spread of virus diseases by late aphid infestations, 2) to reduce late blight tuber rot infections, 3) to make both machine and hand harvesting easier by elimination of vines and weeds, 4) to terminate growth of potato crop whenever desirable for quality purposes or early market demands, 5) to hasten plant maturity as a precursor for hardening or " setting " skin of tubers to reduce skinning and 6) to facilitate early harvesting of seed potatoes in order to increase percentage of seed- size tubers (Murphy, 1968). Vine killing has been of great assistance in the northeast of America since successful crop harvest has depended, at least in part, on the growers' ability to harvest large acreage of a high internal quality raw product before the onset of inclement weather and unfavorable soil conditions (Harrington, 1974)

Vine killing can be done mechanically, chemically or the two methods can be combined (Murphy, 1968). Mechanical desiccation includes beating, rolling, chopping, pulling and burning (Murphy, 1968; Halderson *et al.* 1985). Chemical vine killing started around 1930 with the use of copper sulfate plus agricultural salt (Sodex) to prevent spread of late blight (Murphy, 1968). Chemical desiccation may be done in two separate applications, the second application controlling any regrowth which may occur after a first mechanical or chemical treatment (Halderson *et al.* 1985). After haulm desiccation, a certain delay period must be respected before harvesting, during which tubers loosen from the stolons and skin matures (Callbeck, 1948).

1.2 Problems associated with haulm desiccation

Although desiccation of potato vines has been reported as a desirable technique, it can cause a decrease in tuber quality especially if it is done before normal vine maturity (Murphy, 1968). This decrease in quality may be reflected by internal discoloration of tubers referred to as stem-end discoloration (Scieczka, 1974); by a decrease in germination potential of tubers retained from treated plants (Murphy and Goven, 1973); by a decrease in total solids content or specific gravity (Rowberry and Johnston, 1966); by a decrease in yield (Sieczka, 1980); or by the presence of chemical residues in the tubers (Chrominski and Rozej, 1976). The degree of these negative effects of vine killing on tuber quality depend upon different factors such as rapidity of desiccation, type of chemical used, climatic conditions and age of the plants at treatment time (Callbeck, 1949).

1.2.1 Stem-end discoloration

Hoyman (1947) reported a brown discoloration within and adjacent to the vascular tissue of the Red Warba tubers. Since he observed this discoloration in both treated and untreated tubers, he could not associate this discoloration with chemical desiccation. However he observed that this discoloration was positively correlated with the rapidity of kill and that it was less severe if desiccation was done late in the season when plants are mature.

Observation of this internal discoloration occurred after the replacement of sodium arsenite as the standard treatment by dinitro compounds such as dinoseb(2-sec-butyl-4,6-dinitrophenol) (Sieczka, 1974; Rich, 1950). Further research by Hoyman showed that when potato plants are in a moisture stress, vascular discoloration of tubers can be caused by almost any disturbance of the vegetative plant (in Murphy, 1968). In accordance with this, Murphy and Goven observed that vascular discoloration, in conditions of adequate moisture was not significantly different between tubers from vine killed plants and untreated ones (Murphy and Goven, 1971). Split applications of low rates of chemicals may decrease vascular discoloration when dry and hot climatic conditions prevail (Murphy, 1968).

1.2.2 Germination potential of seed tubers

Germination potential of seed tubers obtained from plants treated by chemical vine killers has been evaluated by many workers (Chrominski and Rozej, 1976, Murphy and Goven, 1973 and others). This potential may be evaluated either by measuring rate of emergence or by measuring sprout weight in grams (Chrominski, 1976 Harrington, 1974). For example the emergence and yield of tubers from treated plants has been shown to be directly related to the application rate of paraquat (1,1 - dimethyl - 4, 4' - bipyridinium ion) (Murphy and Goven, 1973).

1.2.3 Storage of tubers

In order to be acceptable, haulm desiccation must not impair the storage life of potato tubers harvested from treated plants. Such an effect was observed when paraquat was used at high rates (1.1 to 1.4 kg/ha) which increased significantly the breakdown of tubers cut in half (Sieczka, 1972). However other chemical defoliants such as magnesium chlorate have been shown to improve the keeping quality of tubers by increasing rind thickness (Ambrosov and Zagurskaya, 1976). Another desiccant, glyphosate (N-(phosphonomethyl) glycine), has been shown to cause all tubers to rot, either in the field or in storage, because of high accumulation of the dessicant in the tubers (Murphy and Goven, 1974).

1.2.4 Specific gravity of tubers

Specific gravity, or total solids content, is a major factor in tuber quality (Halderson *et al.* 1985). It is determined by the weight in air and water method (Rowberry and Johnston, 1966). Yield and specific gravity are closely related in that a given number of days must elapse after planting before both will tend to a plateau (Halderson *et al.* 1985). Vine killing, if performed before normal vine maturity, has been shown to decrease yield and specific gravity of tubers (Cunningham *et al.* 1959; Rowberry and Johnston, 1966). This phenomenon was investigated by Rowberry and Johnston (1966) who stated that " although there may be slight translocation of photosynthates from the leaves to the tubers, water is still being absorbed by the roots and the tubers are still respiring, so that there is a net percentage loss of total solids. However they noted that after the crop has reach maximum yield, vine killing practices do not impair specific gravity. They concluded that vine killing of late maturing variety, even if it decreases specific gravity, is desirable because it permits the tubers to " set " before harvesting (Rowberry and Johnston, 1966). Slower methods of vine desiccation may also result in higher specific gravity compare to techniques which desiccate the potato plants more rapidly (Terman *et al.* 1952).

1.2.5 Yield of tubers

Since tuber yield continues to increase as long as portions of the vines remain succulent, it is believed that slower methods of haulm desiccation result in higher yields (Terman *et al.* 1952). Also it was reported that there is a significant interaction between cultivars and time of desiccant application for yield of seed tubers (between 35 and 65 mm in diameter) (Sanderson *et al.* 1984). Increase in yield during a slow desiccation may be due to translocation of assimilates from top to tubers and /or water absorption by the tubers (Sanderson *et al.* 1984). However if vine killing is done before normal vine maturity, it will result in a decrease in yield compared to untreated vines, but it will have the advantage of preventing oversized tubers (Murphy, 1968).

1.2.6 Residues of desiccant in tubers

When herbicides are sprayed on tuber bearing crop plants, special attention must be paid to the possibility of herbicide uptake by the tubers and subsequent residue accumulation (Schmidt and Pestener, 1980). Sodium arsenite, which was the most used potato vine desiccant (because of low cost and good performance), was extremely toxic to humans and animals and its use was questioned because of possible toxic residues in soil and tubers (Murphy, 1968). Finally its use was cancelled (Harrington, 1974).

Diquat which is the most potent plant desiccant has been claimed not to accumulate in plant tissues in quantities considered harmful for consumers (Chrominski and Rozej, 1976). However diquat is still a toxic chemical substance to handle and the trend toward the use of chemicals with lower mammalian toxicity has lead to trials with new desiccants.

1.2.7 Influence of climate

Climatic conditions have an important effect on the performance of chemicals used as desiccant. Sieczka (1980) reported that cool and wet weather conditions, which often occur at time of desiccant application, reduce the effectiveness of most of the compounds registered as potato vine desiccants. As an example, variable fall temperature was considered to be the cause for variable efficacy of dinoseb (Mutch *et al.* 1984).

1.3 Hoe-39866 evaluation as a haulm desiccant

A new chemical compound synthetised in the laboratories of Hoechst AG, Hoe-39866 (ammonium-(3-amino-3-carboxypropyl) methylphosphinate) (previously coded as Hoe-00661 and Hoe-7900), was first tested for its herbicidal properties in 1976 under greenhouse conditions (Gotz *et al.* 1983). This product provides good desiccation of potato haulm, but has the adverse effect of inhibiting germination of seed tubers retained from treated plants (Ivany, 1984). Since Hoe-39866 has a good dessication potential, further research need to be conducted in order to verify and quantify the inhibitory effect of Hoe-39866 on sprout germination and to determine if this adverse characteristic may be counteracted.

1.3.1 Status of Hoe-39866

Since 1979, Hoe-39866 has been tested intensively around the world for its possible use in fruit orchards, vineyards, plantation crops (rubber, oil palm, coffee and cocoa), industrial weed control, weed control prior to planting (soybean, cotton) and minimum tillage practice (grain crops) (Gotz *et al.* 1983). Registration of Hoe-39866 has been obtained in the Federal Republic of Germany with the trade name of BASTA® and in the Netherlands with the trade neme of FINALE® (Lindhoud, 1984). Other registrations of the formulated product may have been obtained or will be obtained, but no mention of other registrations was found in the literature consulted.

1.3.2 Physical and chemical properties

The active ingredient of Hoe-39866 is the monoammonium salt of the parent amino acid DL-phosphinotricin, a phosphinic acid analog of glutamic acid (Gotz *et al.* 1983). The parent acid has been initially isolated from a tripeptide antibiotic (bialaphos) produced by Streptomyces viridochromogenes in 1972 (Leason *et al.* 1982) DL-phosphinotricin is obtained in vivo from the hydrolyis of bialaphos (see fig. 1.1) (Corbett *et al.* 1984). Bialaphos was shown to be an effective herbicide due to its metabolism to phosphinotricin in sensitive species (Duke, 1985). Other chemical and physical properties are listed in table 1.2 .

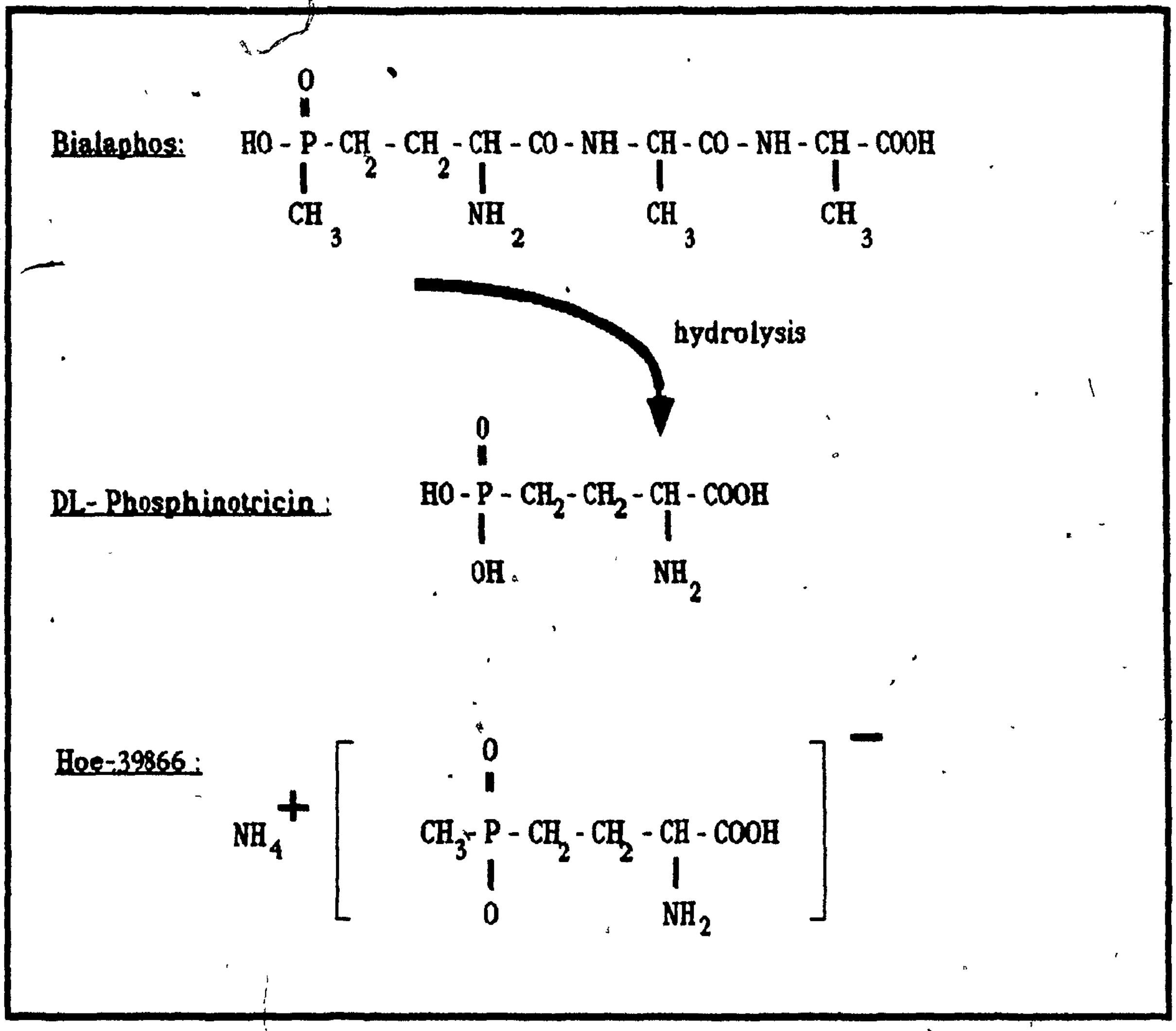


Fig. 1.1 Hoe-39866 and related molecules (adapted from Corbett *et al.* 1984).

Table 1.2 Chemical, physical and toxicological properties of Hoe-39866

chemical formula :	$C_5H_{15}N_2O_4P$	
molecular weight:		198.16 grams
solubility at 20° C: in water,		> 20 gr./100 ml
toxicity: acute oral LD_{50},	mouse:	424 mg a.i./kg bodyweight
	rat:	1810 mg a.i./kg bodyweight

(adapted from Gotz *et al.* 1983).

1.3.3 Mode of action of Hoe-39866

Phytotoxic symptoms after foliar application of Hoe-39866 start with a pale yellowish discoloration of the green parts of the plant which then wither and die after a period of two to five days (Gotz *et al.* 1983). Phosphinotricin and its monoammonium salt, Hoe-39866, are potent inhibitors of the enzyme glutamine synthetase in the leaf tissue (Kocher,1983). Glutamine synthetase is the first enzyme involved in NH_3 assimilation in plants (Leason *et al.* 1982). NH_3 assimilation through glutamine synthetase is illustrated in figure 1.2 (Corbett *et al.* 1984). Under normal conditions the ammonia produced by various metabolic processes (mainly photorespiratory processes) in the plant cell combines with glutamic acid to form glutamine (Gotz *et al.* 1983). " Shortly after application of Hoe-39866 the ammonium metabolism of the plant is disturbed and at the same time photosynthesis is severely inhibited. Accumulation of ammonia, which is toxic to plant cells in higher concentration occurs " (Gotz *et al.* 1983). It was observed that ammonia accumulation was already detectable prior to the inhibition of photosynthetic activity. It is the ammonia accumulation which is thought to interfere with photosynthetic oxygen production, which suggest no direct action of Hoe-39866 on photosynthesis (Kocher, 1983).

Hoe-39866 was also shown to be an inhibitor of other metabolic processes. Lipid synthesis being the more sensitive followed by protein and RNA syntheses which were more affected than photosynthesis. The degree of inhibition being proportional to herbicide concentration (Bellinder *et al.* 1984).

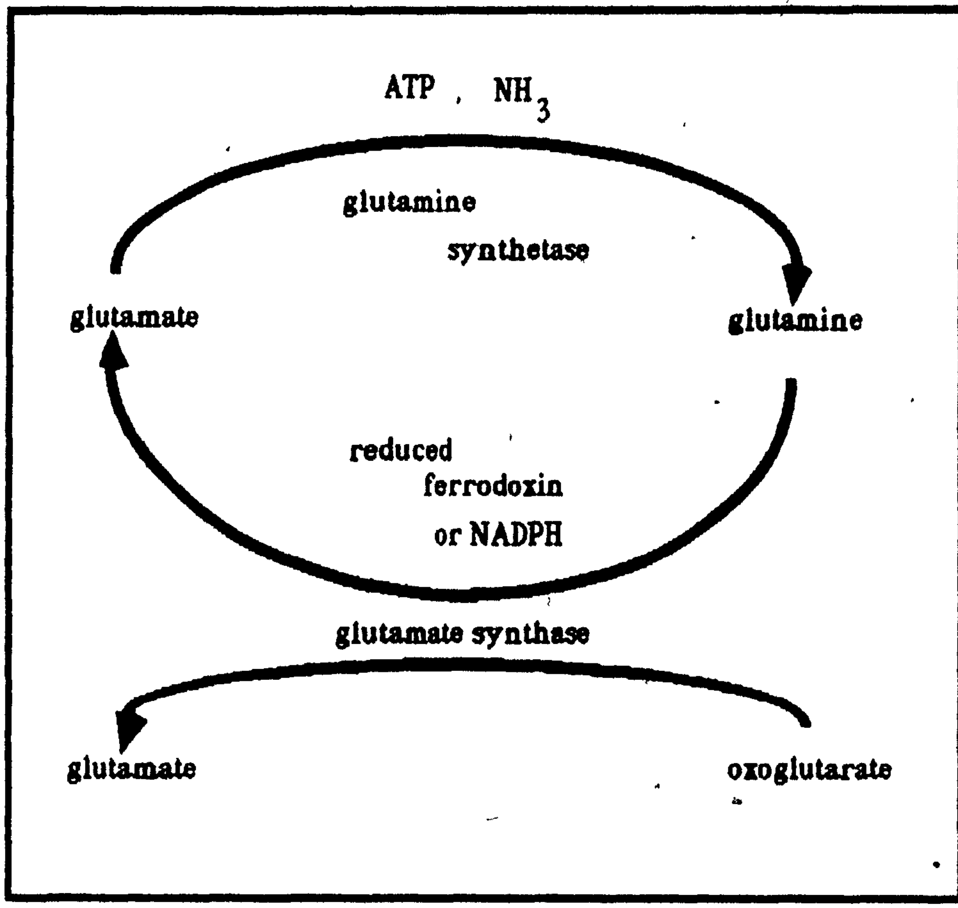


Fig 1.2 NH_3 assimilation in plants (Corbett *et al.* 1984).

1.3.4 <u>Absorption and translocation of Hoe-39866</u>

1.3.4.1 <u>Absorption</u>

Hoe-39866 is absorbed through the leaves of treated plants and is not particularly rainfast when rainfall occurs within six hours, decreasing its activity (Hoechst AG, 1981: Kindhoud, 1984). One day after the application of the formulated product to <u>Sorghum halepense</u>, 19% of the active ingredient had penetrated into the leaves. Two days after application 35% of the applied active ingredient had been absorbed (Gotz *et al.* 1984). No root absorption could be detected (Lindhoud, 1984).

1.3.4.2 Translocation

Translocation of the active ingredient or accumulation of ammonia beyond the treated zone has been detected, which may account for the partial systemic action of Hoe-39866 (Bellinder *et al.* 1985). Gotz *et al* (1983) reported that when leaves of Ipomea sp. and Sorghum halepense were treated, symptoms were observed on the younger untreated leaves and growing points.

Schwertle (in Kocher, 1983) reported that the systemic effect of Hoe-39866 is more or less pronounced depending on the species to be treated. When sprayed on raspberry for cane vigor control, there was no evidence of translocation of the active ingredient to the fruiting canes: but these canes emerged later than those treated with dinoseb-in-oil, which may account for a certain inhibitory effect of Hoe-39866 on regrowth (Lawson and Wiseman, 1983).

When sprayed on Imperata cylindrica, the duration of the period during which regrowth is suppressed is related to the dosage of Hoe-39866, which indicates that the active ingredient has a certain influence on the metabolism in the rhizomes (Langeludekke *et al.* 1983). Kassebeer *et al.* (1983) also noted that Hoe-39866 affects roots or rhizomes but does not destroy them and suggested that the application of the product should be done when the nutrient reserves are fully mobilised and the plant development more advanced in order to get better weed control.

Richardson *et al.* (1982) reported that Agropyron repens recovered well from foliar sprays of Hoe-39866 at a medium dose, but the rhizomes system was less vigorous than the control. At the high dose (1.5 kg a.i. /ha) they noticed that all plant systems were killed. They suggested that translocation of Hoe-39866 could be less than glyphosate. The contact action of Hoe-39866 may be responsible for the limited translocation of the product in the plant (Kocher, 1983).

Although effects on roots and rhizomes has been detected, no action via the roots could be detected after emergence: suggesting the product acts via the leaf

(Lindhoud,1984; Gotz *et al* 1983). Inhibition of shoot regrowth from rhizomes and other subterranean organs of perrenial plant species, could be due to a lack of glutamine for amide transfer reactions (Kocher et Lotzsch, 1985).

1.3.5 Environmental factors affecting Hoe-39866 efficacy

1.3.5.1 Light

" Much larger quantities of ammonia are produced by light dependent processes (nitrate reduction and photorespiration) than by other processes not dependent on light " (Kocher, 1983). It was noticed that in darkness or under very low light intensities ammonia accumulation was strongly reduced and leaf necrosis developed only slowly on treated plants (Kocher, 1983).

1.3.5.2 Temperature

Cold and dry weather will decrease metabolic activity of plants treated with Hoe-39866 and as a result the herbicide activity will be slower (Lindhoud, 1984). High temperature (26 $^{o}C/18$ ^{o}C, day/night) are optimum for herbicidal activity on dicotyledonous species (Donn, 1982).

1.3.6 Soil behavior of Hoe-39866

Reports on soil behavior of Hoe-39866 state that residues do not accumulate in the soil and that the product is completely decomposed to carbon dioxide within a few weeks (Gotz *et al* 1983; Langeluddeke, 1982). Leaching in natural soils is not deeper than 15 cm, but studies on artificial soils in greenhouses has shown leaching of the active ingredient to the deepest layer of soil studied (Gotz *et al* 1983).

1.3.7 Objectives

The present research program was initiated to evaluate the field efficacy of Hoe-39866 as a potato-top desiccant by comparing it to the generally used herbicide diquat. But since Hoe-39866 has been previously reported to interfere with the regenerative potential of tubers, the use of herbicidal combinations (Hoe-39866 plus diquat) was evaluated as a technique to counteract this inhibitory effect on the regenerative potential of tubers. Finally, preliminary studies were conducted to investigate on the possible translocation of Hoe-39866 from top to tubers and/or absorption of the desiccant by the tubers from the soil.

Chapter 2

EVALUATION OF HOE-39866 AS A POTATO-TOP DESICCANT

2.1 Introduction

Hoe-39866 was assayed as a desiccant treatment on three different potato cultivars (Kennebec, Russet Burbank and Sebago). The objectives of the experiments, conducted over two consecutive years (1985 and 1986), were (a) to evaluate the potential of Hoe-39866 as a potato-top desiccant in terms of desiccating performance and yield effects, (b) to determine daughter tuber quality (stem-end browning and regenerative potential) and (c) to compare the performance of Hoe-39866 to diquat, the currently used desiccant in eastern Canada.

2.2 Materials and methods

2.2.1 Plant culture

Seed tubers of the three potato varieties (Kennebec, Russet Burbank and Sebago) were planted on May 21th 1985 and on May 21th 1986 at the Agriculture Canada research station in Harrington, P.E.I.. The three cultivars were planted in three distinct blocks, allowing separate analysis of the data for the three varieties. Soil type was a fine sandy loam (Charlottetown series), of pH 5.8. At planting time, fertiliser (17-17-17) was banded at a rate of 784 kg/ha.

2.2.2 Spraying procedure

Desiccation treaments were allocated to each variety in a randomized complete block design with four replications. Desiccants were sprayed on September 5th 1985 and September 4th 1986 using a compressed air hand sprayer calibrated at a spraying volume of 300 liters/ha and at pressure of 276 kilopascal (40 p.s.i.). Each experimental plot was 3.5 m X 7 m with four rows of potatoes. Desiccant treatments applied were Hoe-39866 at 0.25, 0.50 and 1.0 Kg a.i./ha, diquat at 0.84 kg a.i./ha and an untreated control.

2.2.3. Data collection

2.2.3.1. Desiccation rating

Desiccation of both leaf and stem tissues was visually rated 7, 14 and 21 days after herbicide application. The rating ranged from zero (no effect on the plant tissue) to one hundred (complete desiccation - complete browning and loss of turgidity).

2.2.3.2. Tuber yield

Tubers were harvested mechanically from two center rows of each experimental plot on September 27th in 1985 and on September 28th in 1986. Total weight and weight of graded (sized) tubers were recorded. Tubers were then placed in storage at a temperature of 5 - 7 °C and relative humidity of 90 %.

2.2.3.3 Evaluation of stem end browning

On January 31st 1986 (170 days after treatment), ten tubers were randomly selected from each plot's yield of the 1985 experiment and taken out of storage. Each of these tubers were analysed for stem end browning. Rating for stem end browning was done visually using a scale from zero (0) to ten (10), zero being no browning and ten being severe browning. This experience was repeated for the 1986 experiment.

2.2.3.4. Regenerative potential of tubers

2.2.3.4.1. Effect of Hoe-39866 used as a desiccant on time of emergence and yield of tubers retained from treated plants

On May 22nd 1986 tubers obtained from the yield of the 1985 experiment were taken out of storage. Twenty seed size tubers (whole) were selected randomly from each plot's harvest and planted in a randomized complete block design at Harrington farm P.E.I. on May 27th 1986. Tubers were planted 30 cm apart with the twenty tubers in a six meter length of row. Emergence counts were taken at 28 and at 42 days after planting. On September 18th 1986 all the plots were mechanically harvested. Total weight per plot and weight of graded (sized) tubers were recorded. This experiment was not perfomed for the tubers harvested from the 1986 desiccation experiment because of time limitations.

2.2.3.4.2. Sprouting of tubers retained from treated plants

On may 24th 1986 three tubers were randomly selected from the harvest of each plot of the fall 1985 desiccation experiment. These tubers were then placed , basal end down, in plastic trays previously half-filled with peat moss. The trays were then placed in controlled environment for a period of 28 days under complete darkness, relative humidity of 90 %, and temperature of 20° C. Sprout length was recorded on three eyes per tubers on day 11, 14, 21 and 28 after the beginning of the experiment Fresh weight and dry weight of the sprout growth of the three (3) eyes was recorded at the end of this experiment (after 28 days). This experiment was also performed in the spring of 1987 for the tubers retained from the 1986 desiccation experiment.

2.3 Results

2.3.1 Desiccation performance

A Friedman test was performed for both leaf and stem desiccation of the three cultivars in order to determine if Hoe-39866 and diquat showed similar desiccation results. This test was performed for each period of data collection (7, 14 and 21 days after herbicide application) and for both the 1985 and 1986 experiments.

2.3.1.1 Leaf desiccation

The complete analyses using the Friedman test are presented in Appendix 1 a. There was a significant effect of the different desiccant treaments on each of the three cultivars. In order to locate the differences in desiccation performance, a multiple comparison test (experimentwise error rate = 20 %) was performed using ranked visual ratings (Figure 2.1 to 2.6).

Hoe-39866 used at 0.25 kg a.i./ha) gave slower desiccation results on each of the three cultivars in both 1985 and 1986. Seven days after desiccant application, this low rate had poor desiccation performance when compared to the other desiccant treatments. This difference became less important with time after herbicide application. Twenty - one days after application this treament was similar to the three other ones when applied on the variety Kennebec and Russet Burbank; but on Sebago it was still significantly lower than the highest rate of Hoe-39866 (1.0 Kg a.i./ha).

Hoe-39866, when used at 0.50 and 1.0 Kg a.i./ha, was comparable to diquat in terms of desiccation performance at 7, 14 and 21 days after herbicide application This characteristic was observed on each of the three varieties in both 1985 and 1986.

When comparing results between years, it can be noted that diquat provided higher desiccation in 1986 than in 1985 at 7 days after herbicide application, whereas Hoe-39866 at all rates responded the opposite way.

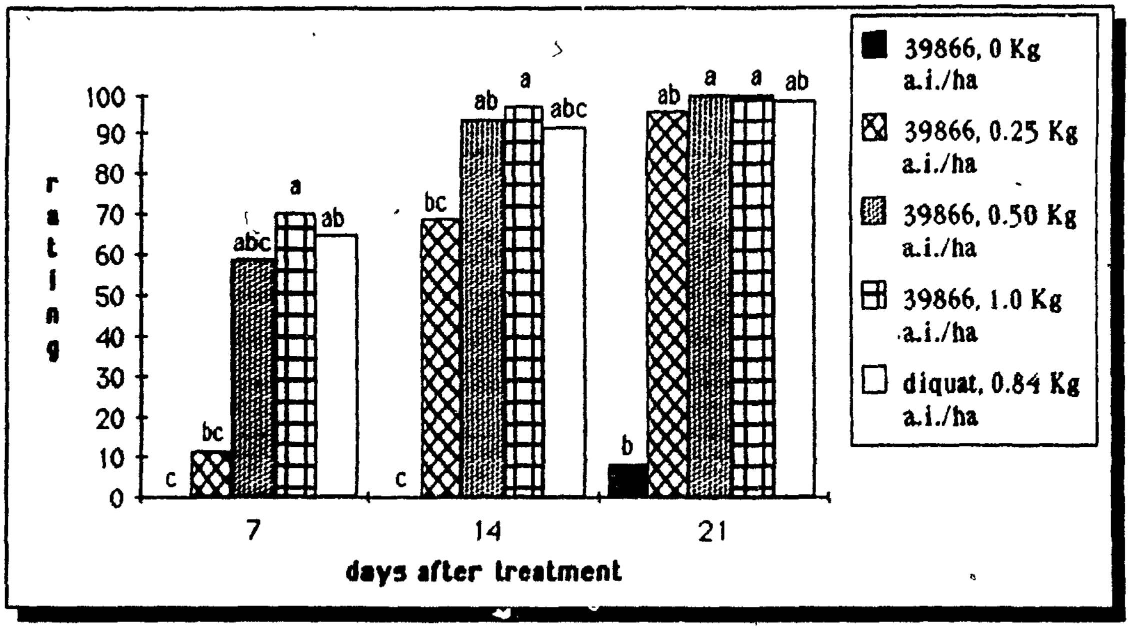


Fig 2.1 Leaf dessication with Hoe-39866 and diquat on the variety Kennebec - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate

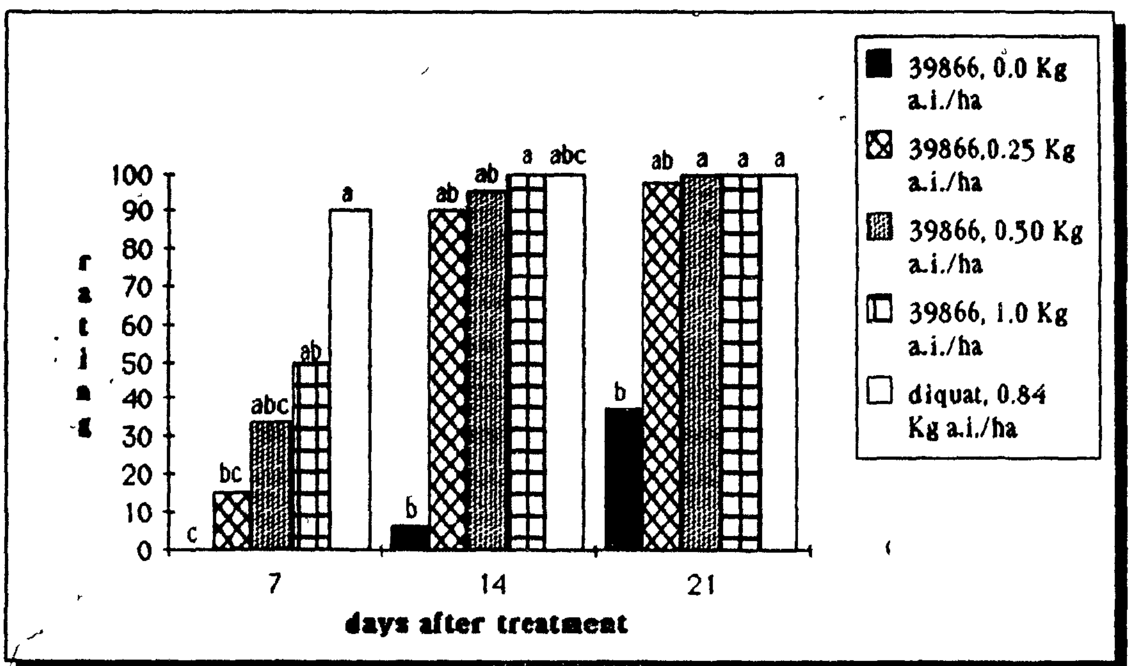


Fig. 2.2 Leaf desiccation with Hoe-39866 and diquat on the variety Kennebec - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

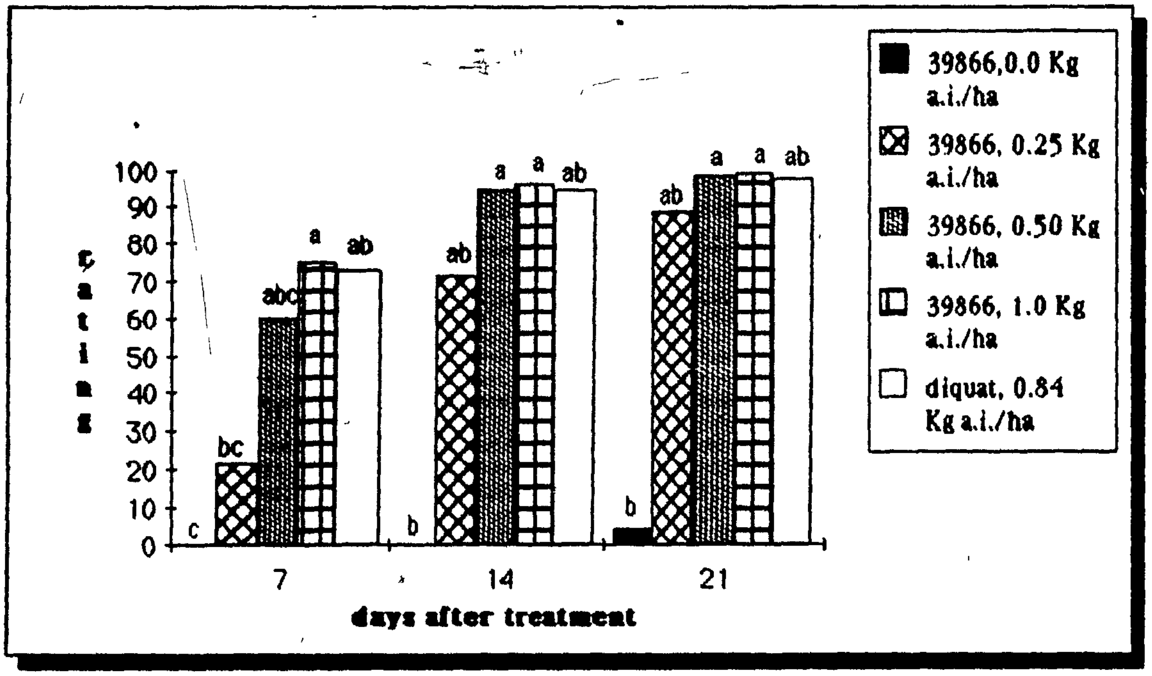


Fig 2.3 Leaf desiccation with Hoe-39866 and diquat on the variety Russet Burbank-1985 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

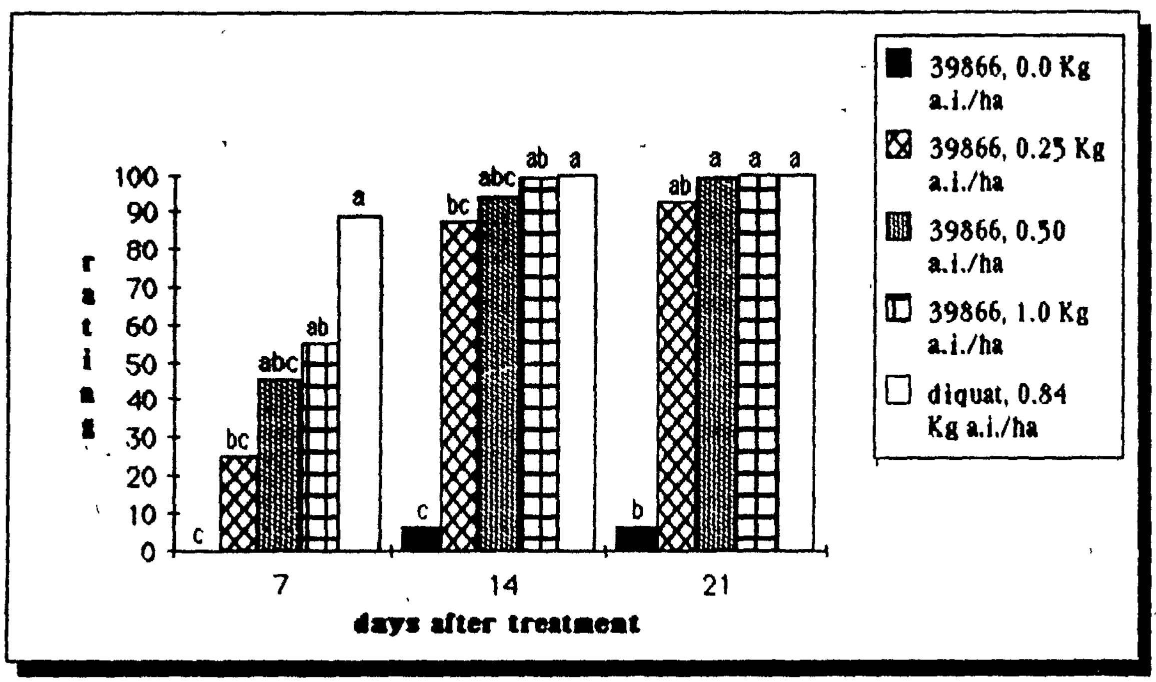


Fig. 2.4 Leaf desiccation of Hoe-39866 and diquat on the variety Russet Burbank - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

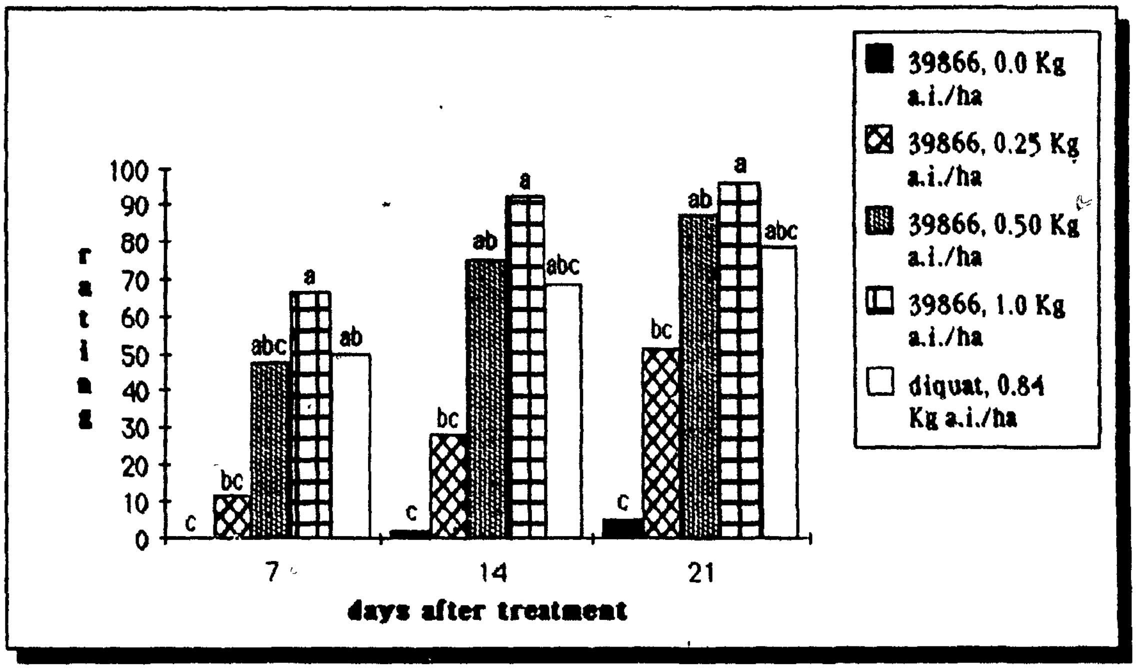


Fig. 2.5 Leaf desiccation with Hoe-39866 and diquat on the variety Sebago - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

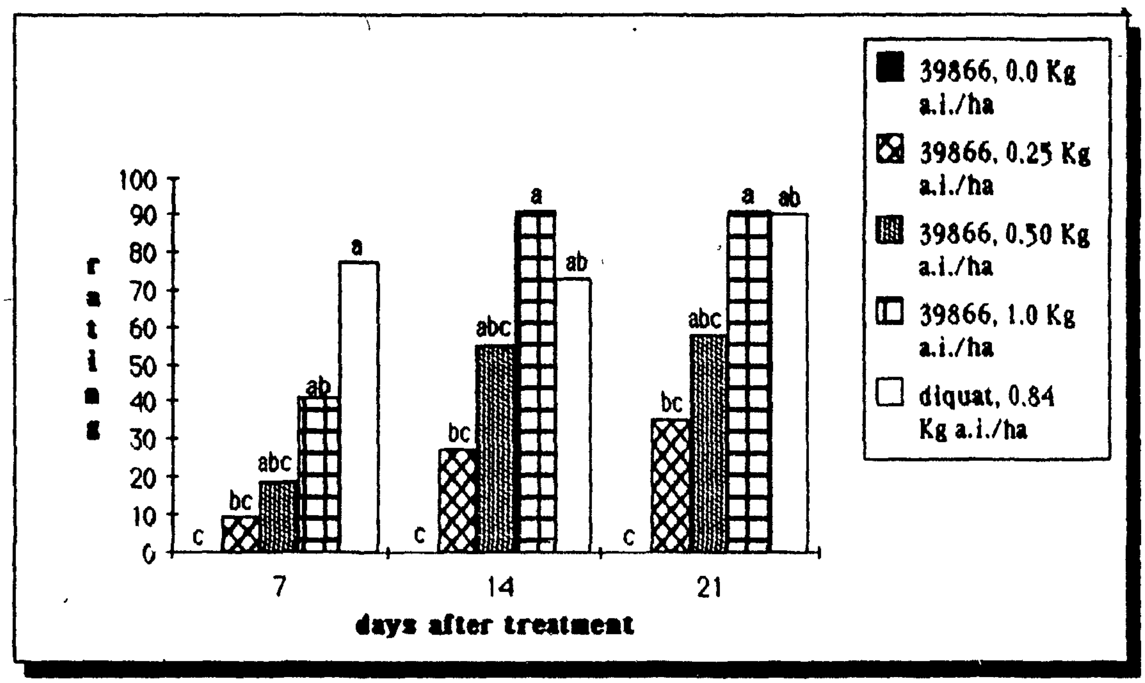


Fig. 2.6 Leaf desiccation witf Hoe-39866 and diquat on the variety Sebago - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

2.3.1.2 Stem desiccation

The complete analyses using the Friedman test are presented in Appendix 1 b. There was a significant effect of the different herbicide treaments on each of the three cultivars except for Kennebec and Sebago, 7 days after herbicide application in 1986. In order to locate differences in desiccation performance, a multiple comparison test was performed using ranked visual ratings (experimentwise error rate = 20 %, except for R. Burbank 21 days, 1986: experimentwise error rate = 30 %) (Figure 2.7 to 2.12).

Hoe-39866, used at a rate of 0.25 kg a.i./ha, did not provide as good a desiccation performance as the other desiccant treatments. This characteristic was particularly noticeable on Sebago in 1985 and 1986 and, to a lesser extent, on the two other varieties 14 days after herbicide application (1986 results).

The two other rates of Hoe-39866 (0.50 and 1.0 kg a.i./ha) were comparable to diquat, the only exception being with the 0.50 kg a.i./ha rate on Sebago. This rate gave lower desiccation results than diquat on this particular variety, but only in 1986 and the difference was not significant.

When comparing results between years, it can be noted that all the desiccant treatments gave higher desiccation results in 1986 on both Kennebec and Russet Burbank. This characteristic however was only noticeable 14 days after herbicide application.

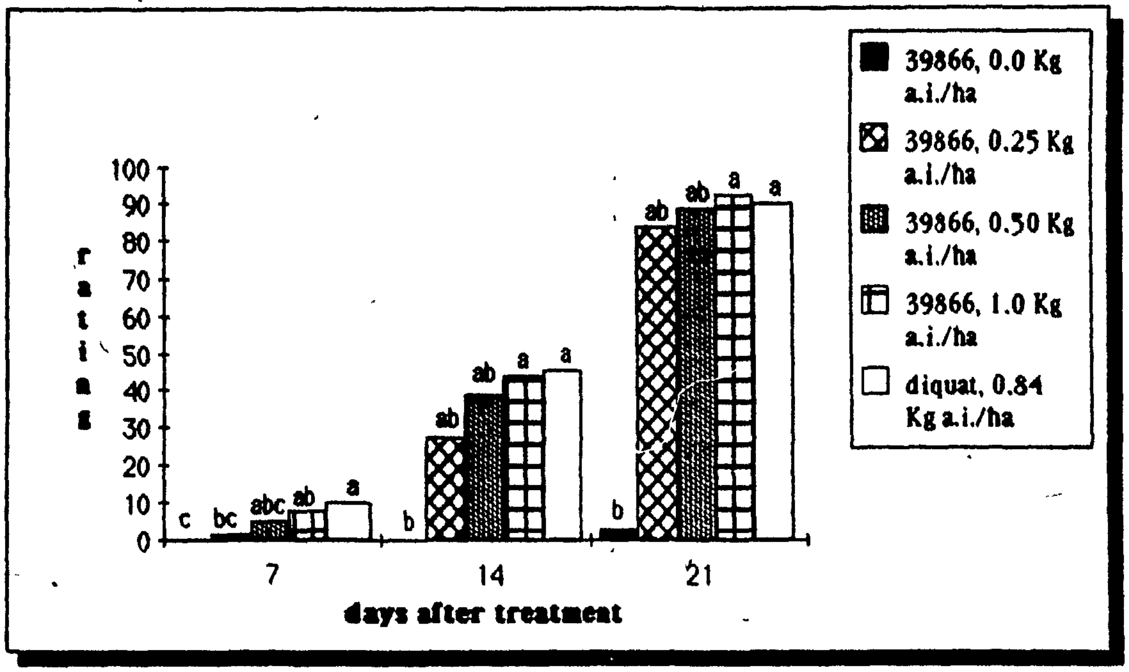


Fig. 2.7 Stem desiccation with Hoe-39866 and diquat on the variety Kennebec - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

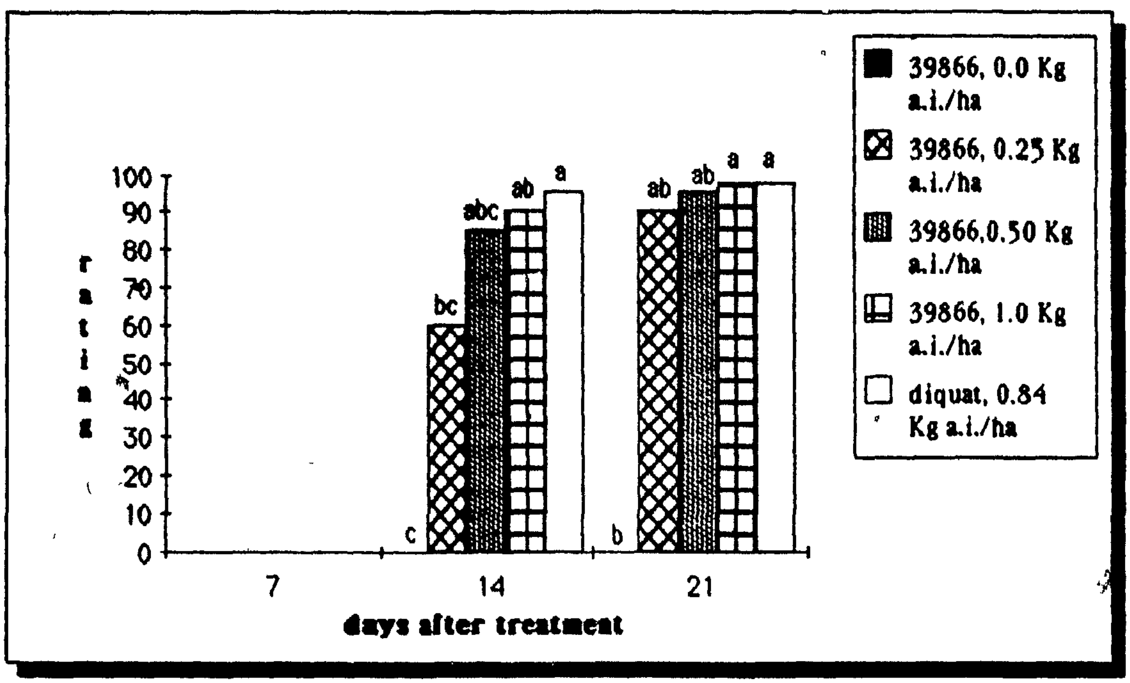


Fig. 2.8 Stem desiccation with Hoe-39866 and diquat on the variety Kennebec - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

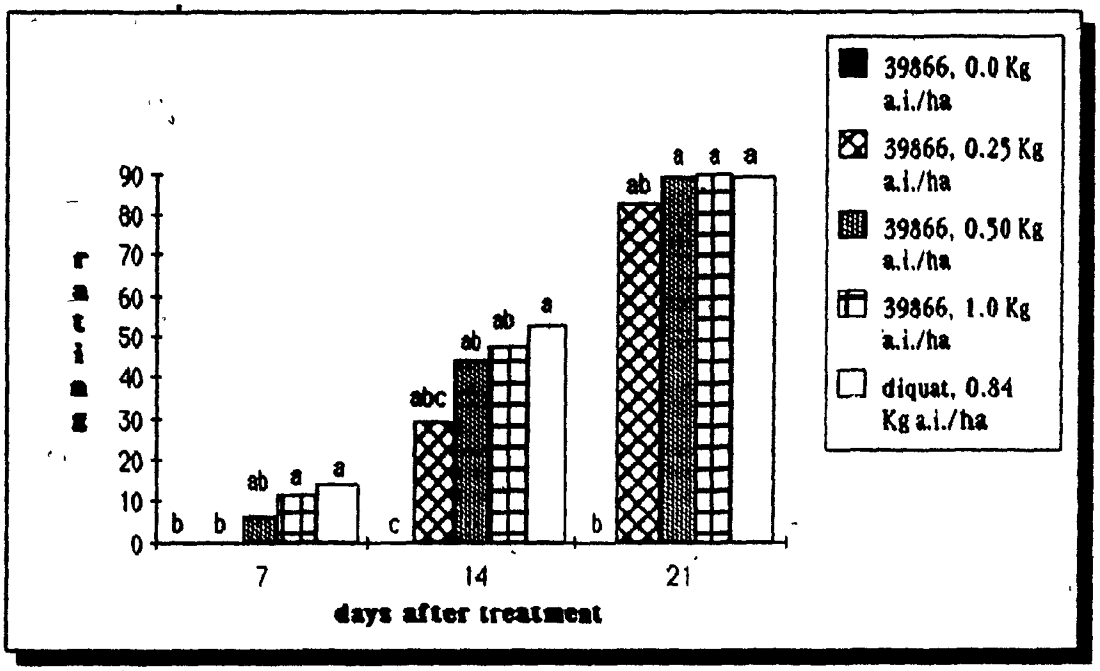


Fig. 2.9 Stem desiccation with Hoe-39866 and diquat on the variety Russet Burbank - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

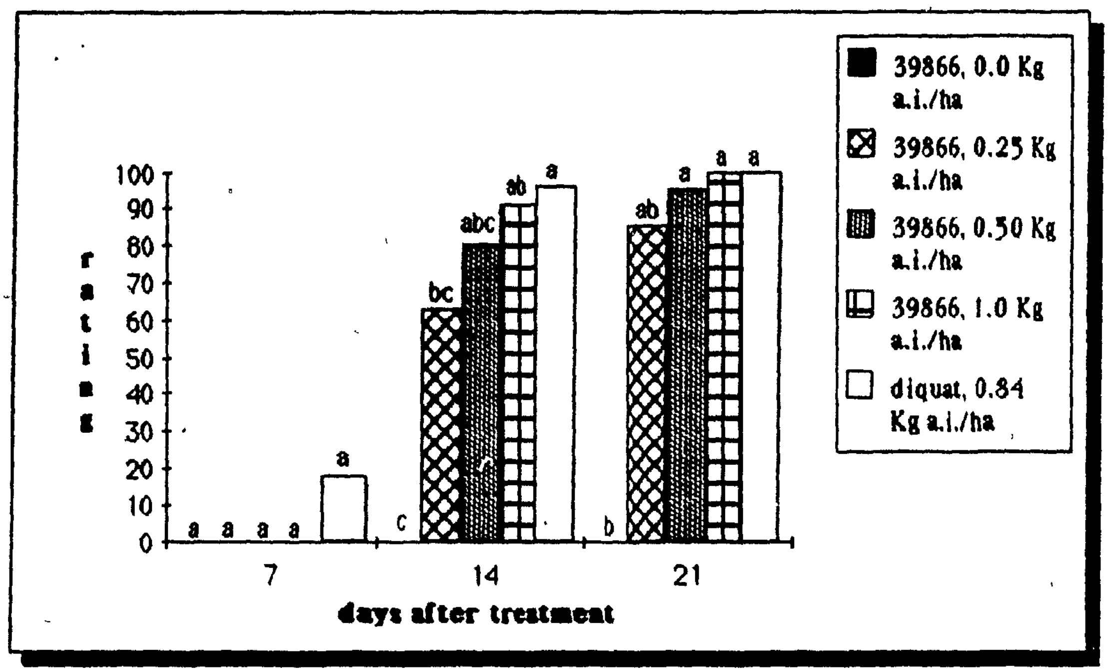


Fig. 2.10 Stem desiccation with Hoe-39866 and diquat on the variety Russet Burbank - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

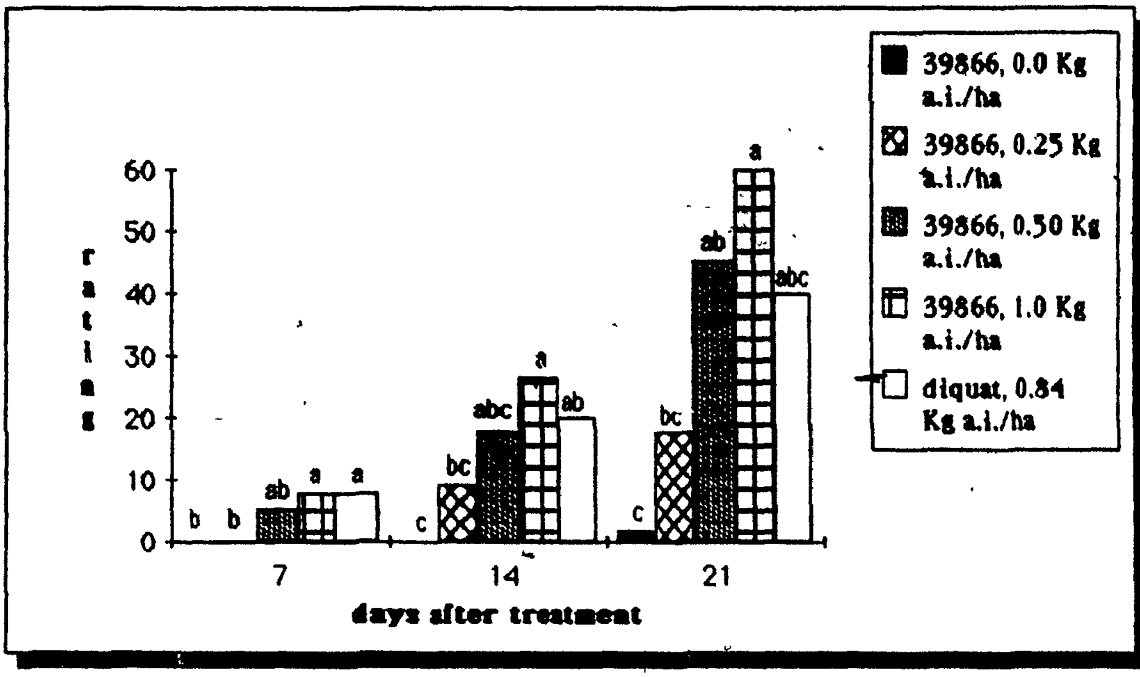


Fig. 2.11 Stem desiccation with Hoe-39866 and diquat on the variety Sebago - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

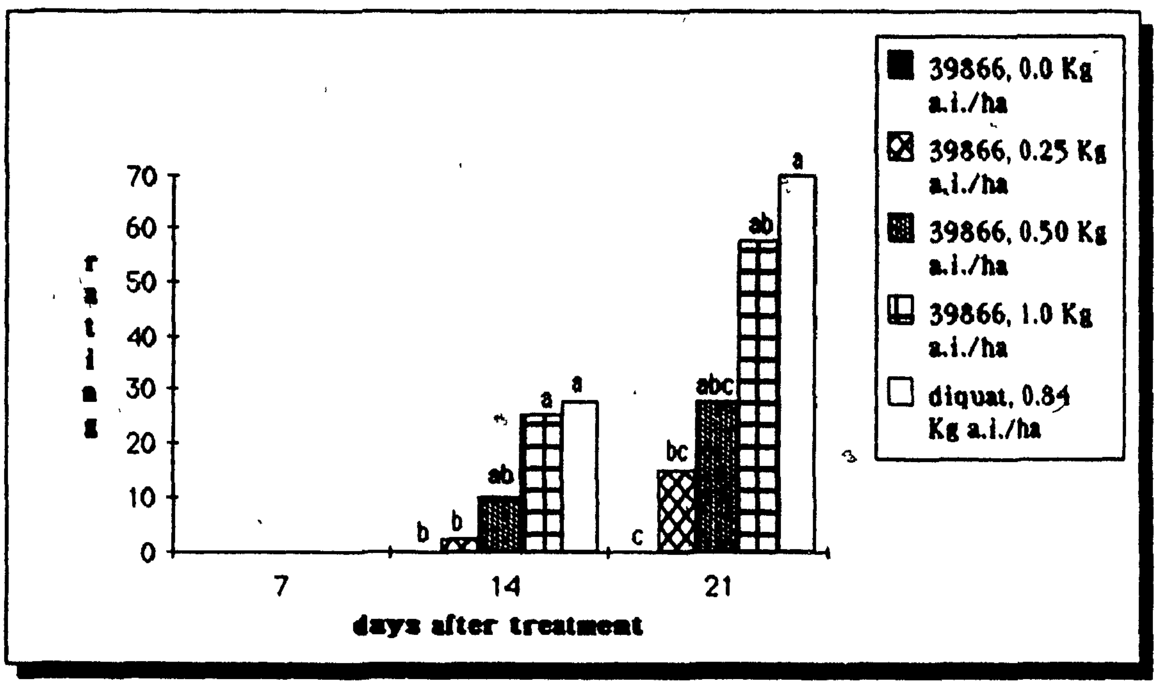


Fig. 2.12 Stem desiccation with Hoe-39866 and diquat on the variety Sebago - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 20% experimentwise error rate.

2.3.2 Tuber yield

Analysis of variance were performed for each grade and total tuber yield of each of the three cultivars in order to determine if the desiccant affected tuber yield. The analyses were done for both the 1985 and 1986 harvests. The complete analyses are presented in Appendices 2a to 2f.

When variances were homogeneous between the two years the data from both years were combined and analyses of variance performed on these combined data The complete analyses are shown in Appendices 3a to 3c. There was a significant effect of the desiccant on the yield of large size tubers for the three varieties. This characteristic was also reflected in the total yield of the two varieties Kennebec and Russet Burbank. On Sebago, this effect could also be noticed, but only on separate year data since variance were not homogeneous between the two years.

A regression analysis was performed for each of the three cultivars considering the yield of sized and total tuber yield as a function of Hoe-39866 rate in kg a.i./ha (Appendix 4). From these analyses the degree of the polynomials describing the data were found and are listed in Tables 2.1, 2.2 and 2.3 .

From these regression equations it was noted, for both Kennebec and Sebago, that the yield of large size tuber was negatively correlated, to a certain extent, to the rate of Hoe-39866 used. This effect was also noticed for the total yield of both Russet Burbank and Sebago. However it should be noticed that these regression equations were significant only when considering the separate year data, the only exception being for Sebago (size D tubers).

Table 2.1 Regression equations of the yield of Kennebec tubers as affected by Hoe-39866 rate of application.

Tuber size	Year	Regression equation	R^2	C.V.	Pr > F
J (80 mm +)	1985	Y = 3.18 - 2.26 H	0.27	66.87	0.037
D (76 -80 mm)	1986	Y = 8.65 - 2.51 H	0.31	38.33	0.0251

Where
Y is the yield/exp. plot in kg
H is Hoe-39866 rate in Kg a.i./ha
R^2 is the coefficient of determination
CV is the coefficient of variability in %
Pr is the probability that the regression equation is due to chance only

Table 2.2 Regression equations of the yield of R. Burbank tubers as affected by Hoe-39866 rate of application.

Tuber size	Year	Regression equation	R^2	C.V.	Pr > F
Total yield	1986	Y = 22.52 - 0.32 H	0.32	5.80	0.0235

Where
Y is the yield/exp. plot in kg
H is Hoe-39866 rate in Kg a.i./ha
R^2 is the coefficient of determination
CV is the coefficient of variability in %
Pr is the probability that the regression equation is due to chance only

Table 2.3 Regression equations of the yield of Sebago tubers as affected by Hoe-39866 rate of application.

Tuber size	Year	Regression equation	R^2	C.V.	Pr > F
J(80 mm +)	1985	Y = 1.92 - 1.84 H	0.39	81.53	0.0096
C(61-75 mm)	1986	Y = 12.41 - 2.50 H	0.44	9.91	0.0052
D(76-80 mm)	1986	Y = 3.21 - 2.22 H	0.60	32.01	0.0004
Total yield	1986	Y = 22.30 - 4.62 H	0.81	4.29	0.0001
D(76-80 mm)	1985-6	Y = 3.60 - 1.41 H	0.17	39.94	0.0189

Where

- Y is the yield/exp. plot in kg
- H is Hoe-39866 rate in Kg a.i./ha
- R^2 is the coefficient of determination
- CV is the coefficient of variability in %
- Pr is the probability that the regression equation is due to chance only

2.3.3 Stem end browning

A Friedman test was performed for both the 1985 and 1986 desiccation experiment in order to determine if desiccation with Hoe-39866 and diquat had any effect on stem end browning of harvested tubers. The complete analyses are presented in Appendix 5.

In general, there was no significant effect associated with chemical desiccation on stem end browning, the only exception being with the cultivar Sebago in the 1986 experiment. A multiple comparison test (experimentwise error rate = 20%) was performed for this particular experiment. From this test it was noted that Hoe-39866 at 1.0 kg a.i./ha resulted in the highest stem-end discoloration rating, which was significantly higher than Hoe-39866 at 0.25 kg a.i./ha, but not significantly different from the other treatments including the control treatment.

2.3.4 Regenerative potential of tubers

2.3.4.1 Time of emergence and yield of plants grown from retained tubers

2.3.4.1.1 Time of emergence

An analysis of variance was performed for each of the three cultivars in order to determine if the emergence of plants grown from retained tubers was affected by chemical desiccation treatment. The completed analyses are listed in Appendix 6. There was a significant effect of the desiccant on emergence of Kennebec and Russet Burbank at both 28 and 42 days after planting and on emergence of Sebago at 42 days after planting only.

A regression analysis was performed for each of the three cultivars considering the emergence of plants as a function of Hoe-39866 rate in kg a.i./ha (Appendix 7). From these analyses the degree of the polynomials describing the data were found and are listed in table 2.4. From these equations it was noted that emergence was negatively correlated to the rate of Hoe-39866 (Figure 2.13). At rates of 0.5 and 1.0 kg a.i./ha emergence for the three varieties was found to be significantly lower from emergence observed under desiccation with diquat.

Table 2.4 Regression equations of the number of emerged plants from retained tubers as affected by Hoe-39866 rate of application.

Cultivar	time	Regression equation	R^2	C.V.	Pr > F
Kennebec	28 days	Y = 19.00 - 8.86 H	0.47	24.49	0.0033
Kennebec	42 days	Y = 20.25 - 3.86 H	0.65	6.00	0.0002
R.Burbank	28 days	Y = 18.55 - 8.11 H	0.49	21.96	0.0027
R.Burbank	42 days	Y = 20.15 - 2.06 H	0.44	4.76	0.0050
Sebago	42 days	Y = 20.95 - 8.41 H	0.38	24.13	0.0107

Where

Y is the number of emerged plants (out of 20)
H is Hoe-39866 rate in Kg a.i./ha
R^2 is the coefficient of determination
CV is the coefficient of variability in %
Pr is the probability that the regression equation is due to chance only

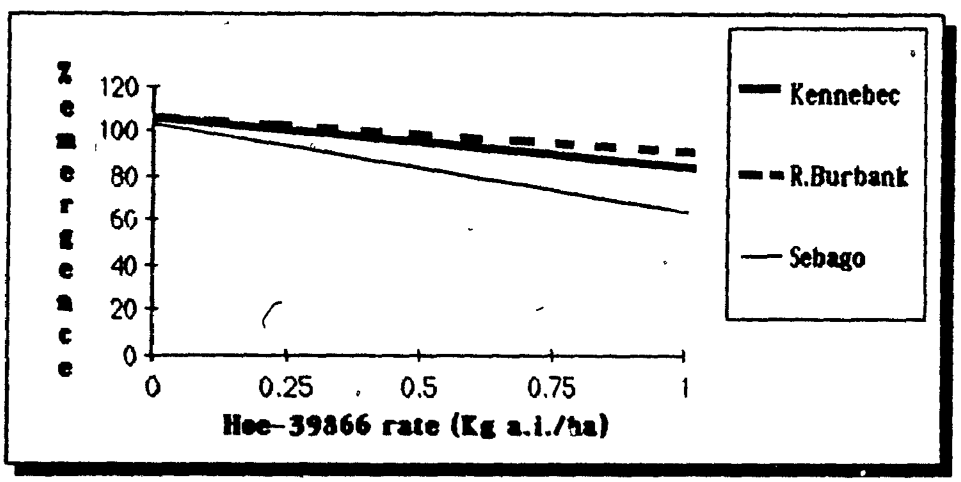


Fig 2. 13 Emergence % of potato plants after 42 days as affected by Hoe-39866 rate of application. Emergence % with diquat used as desiccant is; Kennebec: 99 % , Russet Burbank: 100 % , Sebago: 96 %.
l.s.d. 0.05: Kennebec: 5.61 % , Russet Burbank: 5.17 % , Sebago: 10.85 %

2.3.4.1.2 Yield of tubers from plants grown from retained tubers

An analysis of variance was performed for each of the three cultivars in order to determine if the yield of tubers of plants grown from retained tubers was affected by the chemical desiccation treatment applied the previous year. The complete analyses are listed in Appendix 8. There was a significant effect of the desiccant on total yield of Kennebec and Russet Burbank. But on the total yield of the variety Sebago, this effect was not significant even if increasing rate of Hoe-39866 resulted in lowering the yield of tubers (Figure 2.14).

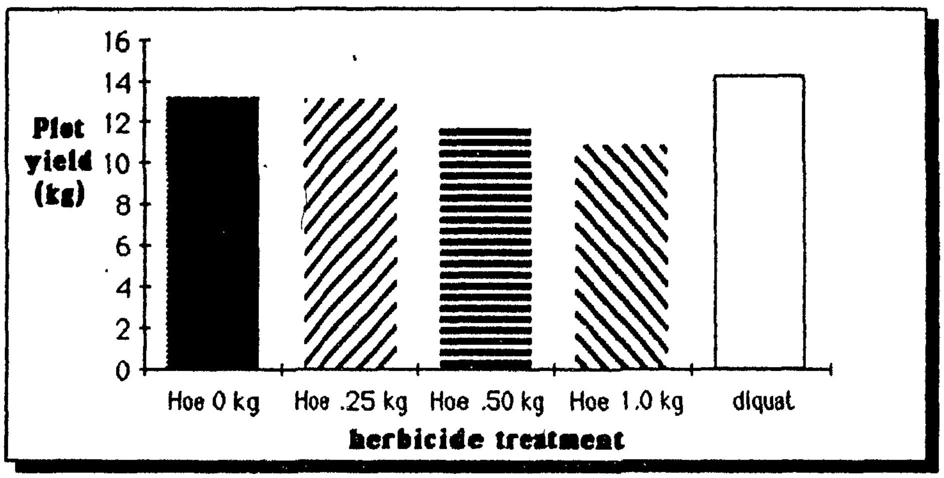


Figure 2.14 Total yield of Sebago plants obtained from retained tubers.

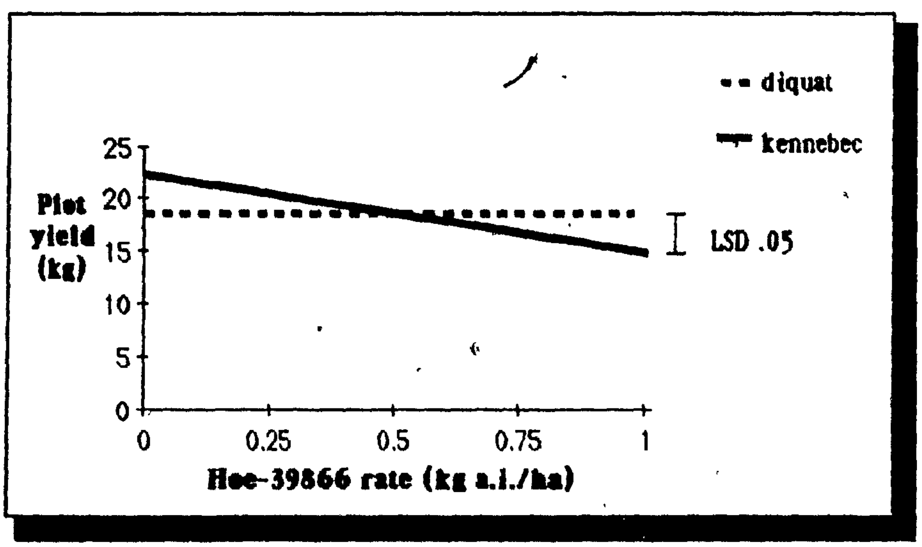
A regression analysis was performed for the two cultivars Kennebec and Russet Burbank considering the total yield of plants as a function of Hoe-39866 rate in kg a.i./ha (Appendix 9) From these analyses the degree of the polynomials describing the data were found and are listed in table 2.5 . From these equations it was noted that total yield was negatively correlated to the rate of Hoe-39866 (figure 2.15 and 2.16). At rates of 0.5 and 1.0 kg a.i./ha total yield for the variety Russet Burbank was found to be significantly different from total yield observed under desiccation with diquat.

Table 2.5 Regression equations of the yield of tubers of plants grown from retained tubers as affected by Hoe-39866 rate of application.

Cultivar	Size	Regression equation	R^2	C.V.	Pr > F
Kennebec	B	Y = 7.27 - 3.45 H	0.45	25.95	0.0042
"	C	Y = 13.11 - 3.79 H	0.41	15.60	0.0073
"	Total	Y = 22.14 - 7.14 H	0.57	12.78	0.0007
R. Burbank	B	Y = 13.04 - 3.69 H	0.47	13.56	0.0034
"	Total	Y = 18.54 - 5.02 H	0.57	10.62	0.0008

Where

Y is the yield in kg per experimental plot
H is Hoe-39866 rate in Kg a.i./ha
R^2 is the coefficient of determination
CV is the coefficient of variability in %
Pr is the probability that the regression equation is due to chance only



2.15 Total yield of Kennebec grown from retained tubers as affected by rate of Hoe-39866.

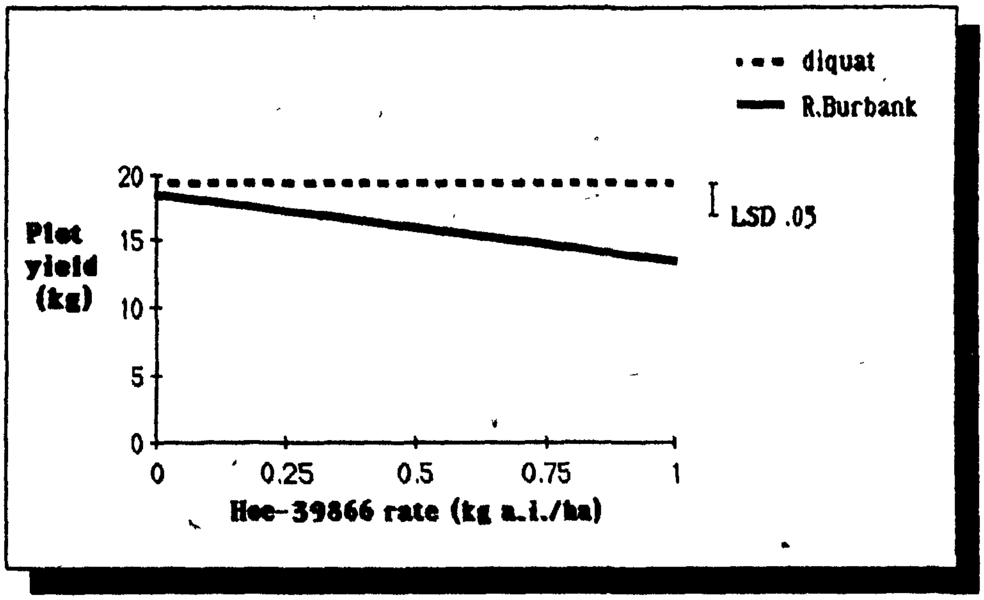


Fig. 2.16 Total yield of Russet Burbank plants grown from retained tubers as affected by rate of Hoe-39866.

2.3.4.2 Sprouting of tubers retained from treated plants

Analyses of variance were performed on the sprout growth of tubers retained from treated plants for each of the three cultivars in order to determine if the desiccant affected sprout growth. The analyses were done for both the 1986 and 1987 experiments. The complete analyses are presented in Appendices 10 a to 10 f.

When variances were homogeneous between the two years the data from both years were combined and analyses of variance performed on these combined data. The complete analyses are shown in Appendices 11 a to 11 c. There was a significant effect of the desiccant on the sprout growth for each of the three varieties. On Kennebec and Sebago this effect was noted on both sprout length (14, 21 and 28 days) and sprout weight (fresh and dry). On Russet Burbank this effect was observed only at 14 days which was the only reading for which variances were homogeneous. However the effect of the desiccant on sprout growth was significant for all the other readings analysed separately.

A regression analysis was performed on the combined data (except Russet Burbank) for each of the three cultivars considering sprout growth as a function of Hoe-39866 rate in kg a.i./ha (Appendix 11 a to 11 c). From these analyses the degree of the polynomials describing the data were found and are listed in Table 2.6 to 2.8 .

From these regression equations it was noted that sprout growth of retained tubers from each of the three varieties was negatively correlated to the rate of Hoe-39866 used. The regression equations with the highest coefficient of determination were kept to draw regression lines. For each of the three cultivars, this was obtained for the sprout length at 28 days (Figure 2.17 to 2.19). Sprout growth for the two varieties Kennebec and Russet Burbank, was found to be significantly different, at all rates of Hoe-39866, from that under desiccation with diquat. For the cultivar Sebago this significant difference was only found at rates of 0.5 and 1.0 kg a.i./ha.

Table 2.6 Regression equations of sprout growth of retained tubers as affected by Hoe-39866 rate of application. Kennebecs 1986-87 combined results.

Dependent variable	Regression equation	R^2	C.V.	Pr > F
sprout length day 14	Y = 34.06 - 9.80 H	0.18	27.04	0.0162
sprout length day 21	Y = 44.69 - 18.51 H	0.36	25.53	0.0003
sprout length day 28	Y = 58.13 - 30.30 H	0.39	32.15	0.0001
fresh weight day 28	Y = 3.49 - 2.30 H	0.31	53.09	0.001
dry weight day 28	Y = 0.47 - 0.28 H	0.26	51.53	0.0026

Where
H is Hoe-39866 rate in Kg a.i./ha
R^2 is the coefficient of determination
CV is the coefficient of variability in %
Pr is the probability that the regression equation is due to chance only

Table 2.7 Regression equation of sprout growth of retained tubers as affected by Hoe-39866 rate of application. Russet Burbank 1987 results.

Dependent variable	Regression equation	R^2	C.V.	Pr > F
sprout length day 28	Y = 77.88 - 66.16 H	0.71	-	0.0001

Where

H is Hoe-39866 rate in Kg a.i./ha
R^2 is the coefficient of determination
CV is the coefficient of variability in %
Pr is the probability that the regression equation is due to chance only

Table 2.8 Regression equations of sprout growth of retained tubers as affected by Hoe-39866 rate of application. Sebago 1986-87 combined results.

Dependent variable	Regression equation	R^2	C.V.	Pr > F
sprout length day 14	Y = 31.58 - 14.76 H	0.40	27.36	0.0001
sprout length day 21	Y = 37.96 - 18.10 H	0.43	26.56	0.0001
sprout length day 28	Y = 43.04 - 22.86 H	0.45	29.34	0.0001
fresh weight day 28	Y = 2.32 - 1.53 H	0.22	67.88	0 0072
dry weight day 28	Y = 0.34 - 0.21 H	0.20	66.56	0.0104

Where

H is Hoe-39866 rate in Kg a.i./ha
R^2 is the coefficient of determination
CV is the coefficient of variability in %
Pr is the probability that the regression equation is due to chance only

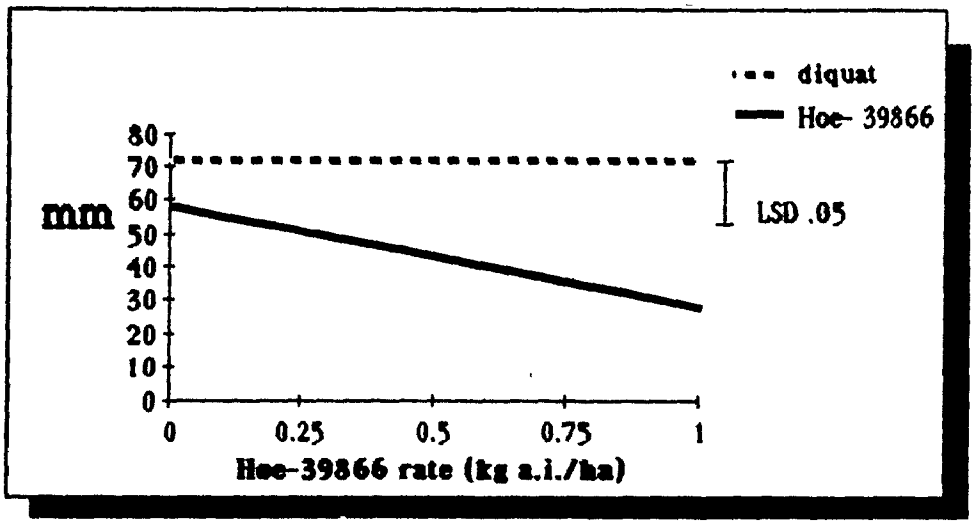


Fig 2.17 Sprout length of retained Kennebec tubers (day 28) as affected by rate of Hoe-39866.

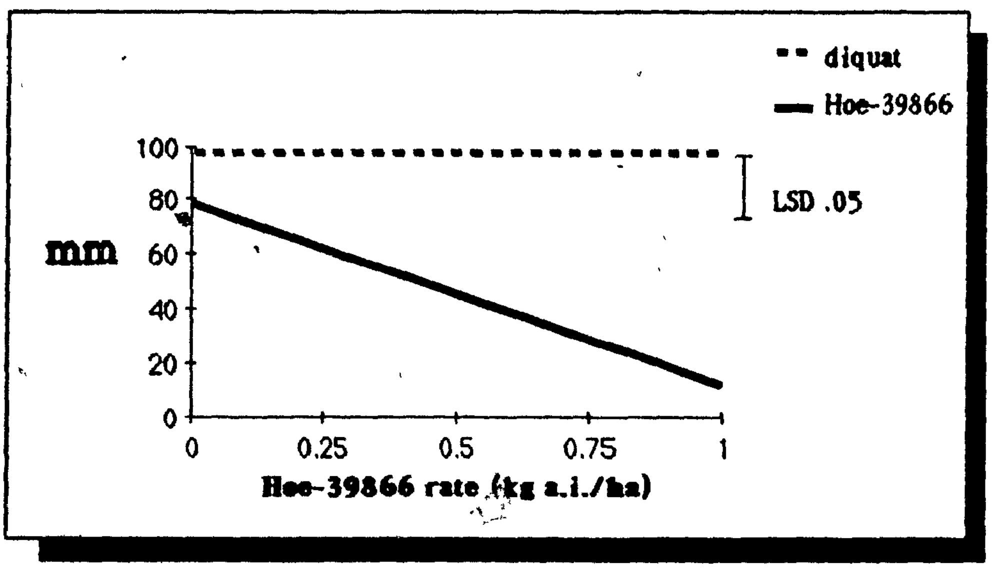


Fig 2.18 Sprout length of retained Russet Burbank tubers (day 28) as affected by rate of Hoe-39866.

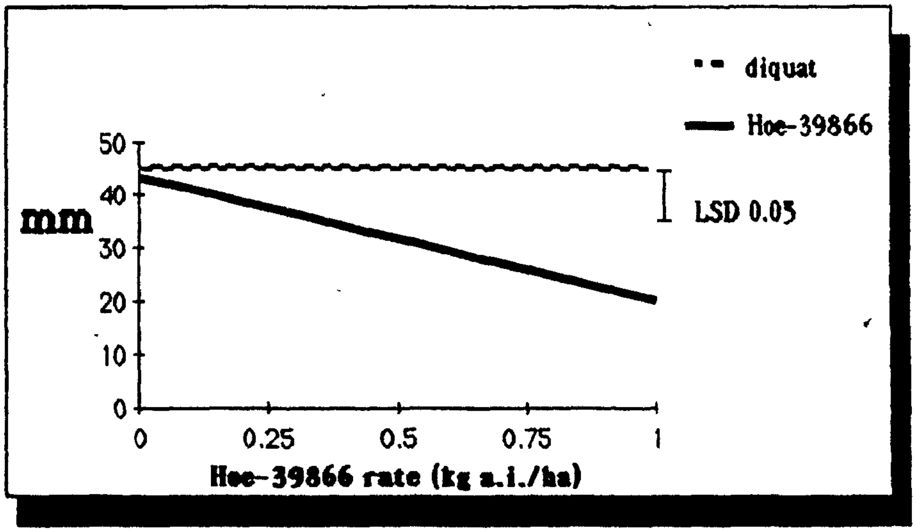


Fig 2.19 Sprout length of retained Sebago tubers (day 28) as affected by rate of Hoe-39866.

2.4 Discussion

2.4.1 Desiccation performance

2.4.1.1 Leaf desiccation

In general, leaf desiccation with Hoe-39866 was not as rapid as leaf desiccation with diquat. However, increasing the rate of Hoe-39866 tended to reduce this difference. Hoe-39866 used at 0,25 kg a.i./ha did not gave satisfactory results on the cultivars Russet Burbank and Sebago, but on the cultivar Kennebec this rate of Hoe-39866 was as good a desiccation treatment as the standard diquat treatment.

Hoe-39866 used at 0,50 and 1,00 kg a.i./ha gave desiccation results comparable to diquat and achieved acceptable desiccation, 21 days after application, on both the cultivars Kennebec and Russet Burbank. On Sebago, the 0,50 kg a.i. rate of Hoe-39866 did not gave satisfactory desiccation, making this treatment unacceptable for this particular cultivar which is not as easy to desiccate as the two other varieties studied (Ivany, personal communication).

The reduced performance of the 0,25 and 0,50 kg a.i./ha rate of Hoe-39866 on the cultivar Sebago in 1986, may have been due to difference in climatic conditions. Cool and dry weather have been shown to decrease the activity of Hoe-39866 (section 1.3.5.2).

2.4.1.2 Stem desiccation

As observed for leaf desiccation, stem desiccation with Hoe-39866 was not as rapid as with diquat, and especially at the 0,25 and 0,50 kg a.i./ha. Hoe-39866 used at 1,00 kg a.i./ha, and on the three cultivars studied, gave as good a desiccation as the standard diquat treatment.

At the 0,50 kg a.i./ha rate, Hoe-39866 provided good desiccation of both the varieties Kennebec and Russet Burbank. However, on the cultivar Sebago, this treament did not give satisfactory desiccation, 21 days after treatment, making it an unacceptable treatment for this particular variety. The 0,25 kg a.i. rate of Hoe-39866 did not provide acceptable level of stem desiccation for the three varieties in both 1985 and 1986. The reduced performance of the 0,25 and 0,50 kg a.i./ha rate of Hoe-39866 on the cultivar Sebago in 1986, may have been due to difference in climatic conditions (section 1.3.5 2).

2.4.2 Tuber yield

The yield of large size tubers of the cultivars Kennebec and Sebago and the total yield of the cultivars Russet Burbank and Sebago was affected, to a certain extent, by the rate of Hoe-39866. Since desiccation was done before normal vine maturity, these reductions in yield is in accordance with the findings of Murphy (1968).

2.4.3 Stem-end discoloration

In general there was no significant effect associated with chemical desiccation on stem- end discoloration. However on the cultivar Sebago, in 1986, stem-end discoloration of tubers treated with Hoe-39866 at 1,00 kg a.i./ha had a significantly higher stem-end discoloration rating as when treated with Hoe-39866 at 0,25 kg a.i./ha. This increased discoloration may have been caused by the rapid desiccation obtained with Hoe-39866 at 1,00 kg a.i./ha. These observations are in accordance with the findings of Hoyman (1947).

2.4.4 Regenerative potential of tubers

2.4.4.1 Time of emergence and yield of plants grown from retained tubers

2.4.4.1.1 Time of emergence

There was a direct negative correlation of the rate of Hoe-39866 on the emergence of plants grown from retained tubers. This inhibitory effect on regrowth, observed on each of the three cultivars, may be due to the systemic action of Hoe-39866 as reported in section 1.3.4.2 .

2.4.4.1.2 Yield of tubers from plants grown from retained tubers

A direct negative correlation of the rate of Hoe-39866 on the yield of tubers retained from desiccated plants was observed on both the variety Kennebec and Russet Burbank. This reduction in yield, under the different Hoe-39866 treatments, may be the result of the delayed emergence observed on these two varieties as well as a reduction in emergence percentage. Some reductions in yield were observed (with increasing Hoe-39866 rates) on the cultivar Sebago, but these reductions were not important enough to be considered significant.

The inhibition effect on yield of retained tubers may have been caused by an indirect effect of Hoe-39866 which, by delaying and reducing emergence of plants from treated tubers, have resulted in shortening the growing period of the plants and decreased their yield. Such an effect have been reported with other chemicals such as diquat (Murphy and Goven,1973).

2.4.4.2 Sprouting of tubers retained from treated plants

Increasing the rate of Hoe-39866 for desiccation purposes decreased proportionally the sprout length and weight of tubers retained from desiccated plants. This inhibitory effect may have been caused by the partial systemic action of Hoe-39866, as reported on other plant species (section 1.4.3.2).

2.4.5 General discussion

Acceptable desiccation performances were obtained when Hoe-39866 was used at rates of 0,50 and 1,0 kg a.i./ha for the two cultivars Kennebecs and Russet Burbank and at a rate of 1,0 kg a.i./ha on the cultivar Sebago. However at these specific rates and cultivar combinations, inhibition of the regenerative potential of tubers retained from treated plants (i.e. emergence, sprout growth and yield), suggests a relatively important systemic action of Hoe-39866 in potato plants.

Chapter 3

EVALUATION OF REDUCED RATES OF HOE-39866 COMBINED WITH DIQUAT AS A POTATO-TOP DESICCANT TREATMENT

3.1 Introduction

Different combinations of reduced rates of Hoe-39866 and diquat were assayed as new desiccant treatments on three different potato cultivars (Kennebec, Russet Burbank and Sebago). The objectives of the experiments, done over two consecutive years (1985 and 1986), were to evaluate the potential use of these desiccant combinations as vine killing treaments in terms of, desiccating performance, yield effects and daughter tubers quality (stem- end browning and regenerative potential) and, to compare the performance of these treatments to the standard desiccant treatment (diquat, 0.84 kg a.i./ha) in eastern Canada.

3.2 Materials and methods:

With the exception of the specific treatments, the experimental procedures used for the evaluation of the combinations of Hoe 39866 and diquat as desiccation treatments were the same as those described in section 2.2. The treatments applied are listed in table 3.1.

The procedures involved in parameter measurements: 1) leaf and stem desiccation, 2) tuber yield, 3) stem-end browning 4) emergence and yield of plants grown from retained tubers and 5) sprouting of retained tubers were identical to those previously described (section 2.2.3).

Table 3.1 Treatment list

Treatment	Rate (kg a.i./ha)
1. diquat	0.84
2. Hoe-39866	0.25
3. Hoe-39866	0.375
4. Hoe-39866	0.50
5. Hoe-39866 + diquat	0.25 + 0.42
6. Hoe-39866 + diquat	0.375 + 0.42
7. Hoe-39866 + diquat	0.50 + 0.42
8. Control	-

3.3 Results

3.3.1 Desiccation performance

A Friedman test was performed for both leaf and stem desiccation of the three cultivars in order to determine if low rates of Hoe-39866 used alone and in combination with diquat showed similar desiccation results as the standard desiccation treatment (i.e. diquat 0.84 kg a.i./ha). This test was performed for each period of data collection (7, 14 and 21 days after desiccant application) and for both the 1985 and 1986 experiments.

3.3.1.1 Leaf desiccation

The complete analyses using the Friedman test are presented in Appendix 13 There was a significant effect of the different desiccant treaments on each of the three cultivars. In order to locate the differences in desiccation performance, a multiple comparison test (experimentwise error rate = 25 %, except for Kennebec 21 days, 1986: experimentwise error rate = 60 % and R. Burbank 21 days, 1986: experimentwise error rate = 30 %) was performed using ranked visual ratings (Figure 3.1 to 3.6).

Hoe-39866 used at 0.250 and 0.375 kg a.i./ha gave slower desiccation than the other desiccant treatments on each of the three cultivars in both 1985 and 1986. However twenty one days after desiccant application desiccation from all desiccant treaments were similar on varieties Kennebec and Russet Burbank; but on Sebago desiccation performance of the lower rates of Hoe-39866 (0 250 and 0.375 kg a.i./ha) was still significantly lower than the standard diquat treatment.

Hoe-39866, when used at 0.50 kg a.i./ha, was comparable to diquat in terms of desiccation performance when rated at 7, 14 and 21 days after desiccant application This characteristic was observed on each of the three varieties in both 1985 and 1986.

The addition of 0.42 kg a.i./ha of diquat to the low rates of Hoe-39866 substantially improved the desiccating performance of these treatments on the three cultivars and for the two years of data collection. This enhancement was particularly noticeable on the cultivars Kennebec and Russet Burbank, 7 days after desiccant application, but on Sebago, the improvement was still appreciable 21 days after desiccant application for both the 1985 and 1986 set of data.

When comparing results between years, desiccation of the cutivar Sebago was slower in 1986 than in 1985 with all treaments showing lower ratings at all periods of evaluation.

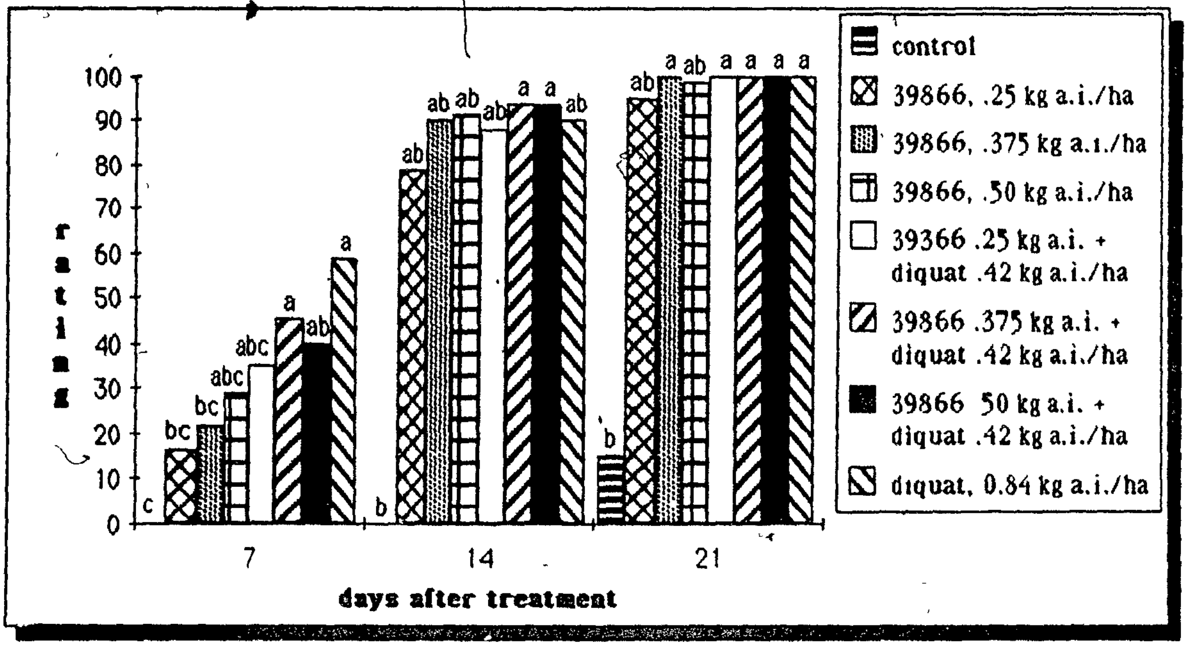


Fig 3.1 Leaf desiccation with Hoe-39866 alone and combined with diquat on the variety Kennebec - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate.

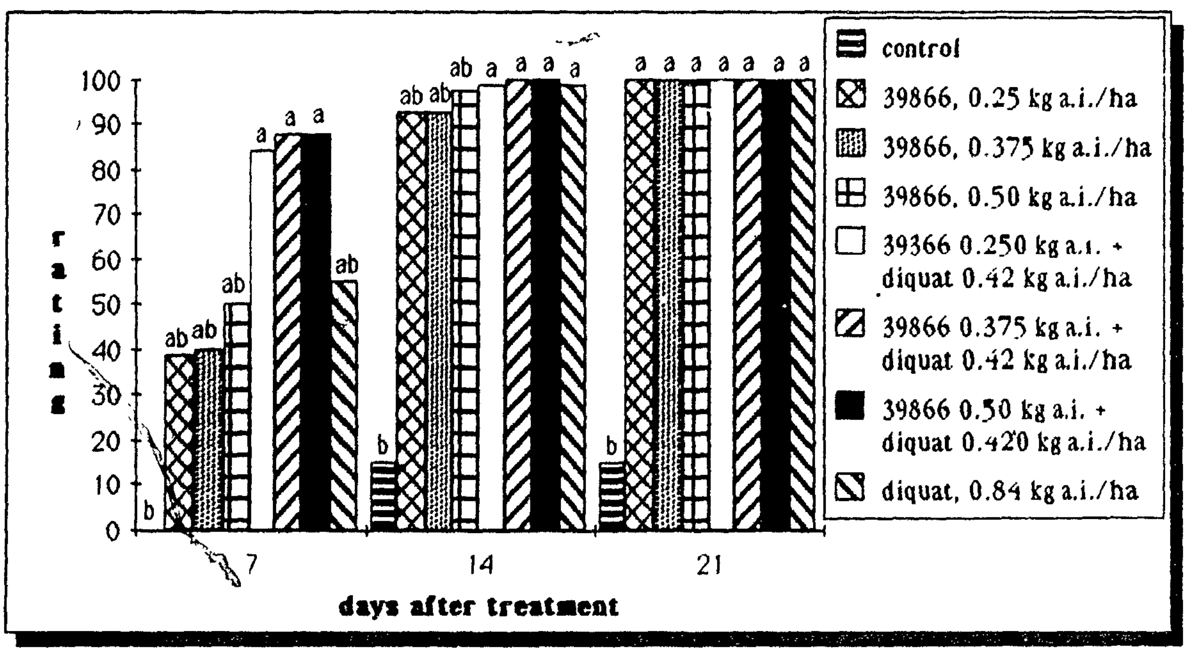


Fig 3.2 Leaf desiccation with Hoe-39866 alone and combined with diquat on the variety Kennebec - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate (except for 21 days: error rate= 60%)

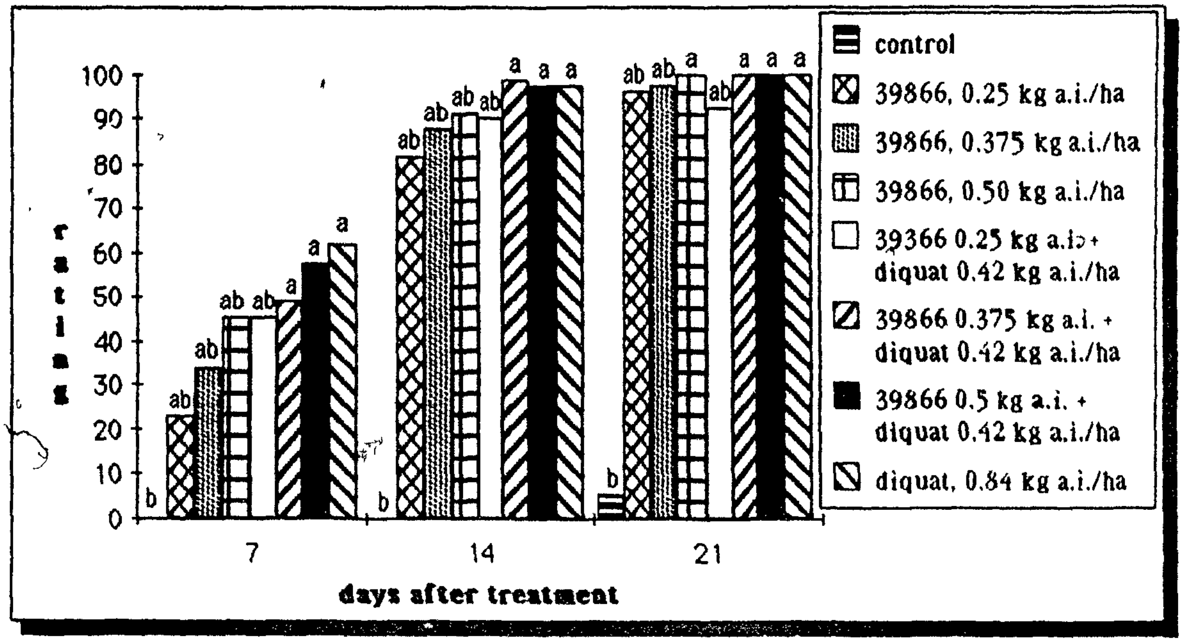


Fig 3.3 Leaf desiccation with Hoe-39866 alone and combined with diquat on the variety Russet Burbank - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate.

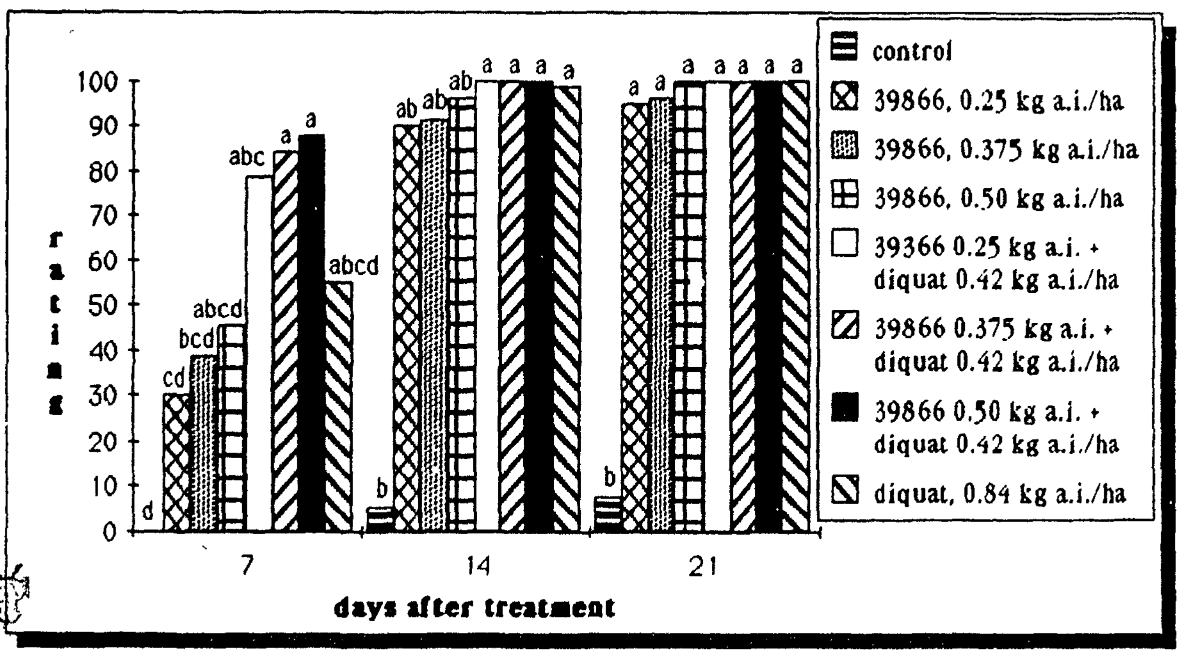


Fig 3.4 Leaf desiccation with Hoe-39866 alone and combined with diquat on the variety Russet Burbank - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate (exceot for 21 days: error rate = 30%)

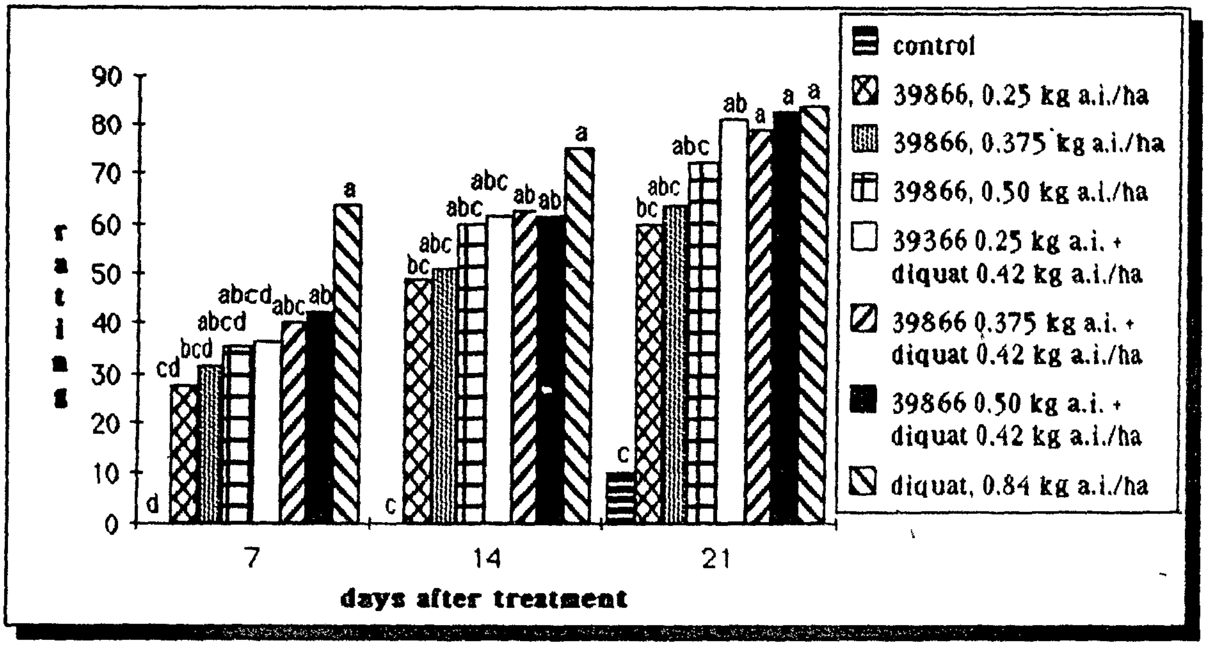


Fig 3.5 Leaf desiccation with Hoe-39866 alone and combined with diquat on the variety Sebago - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate.

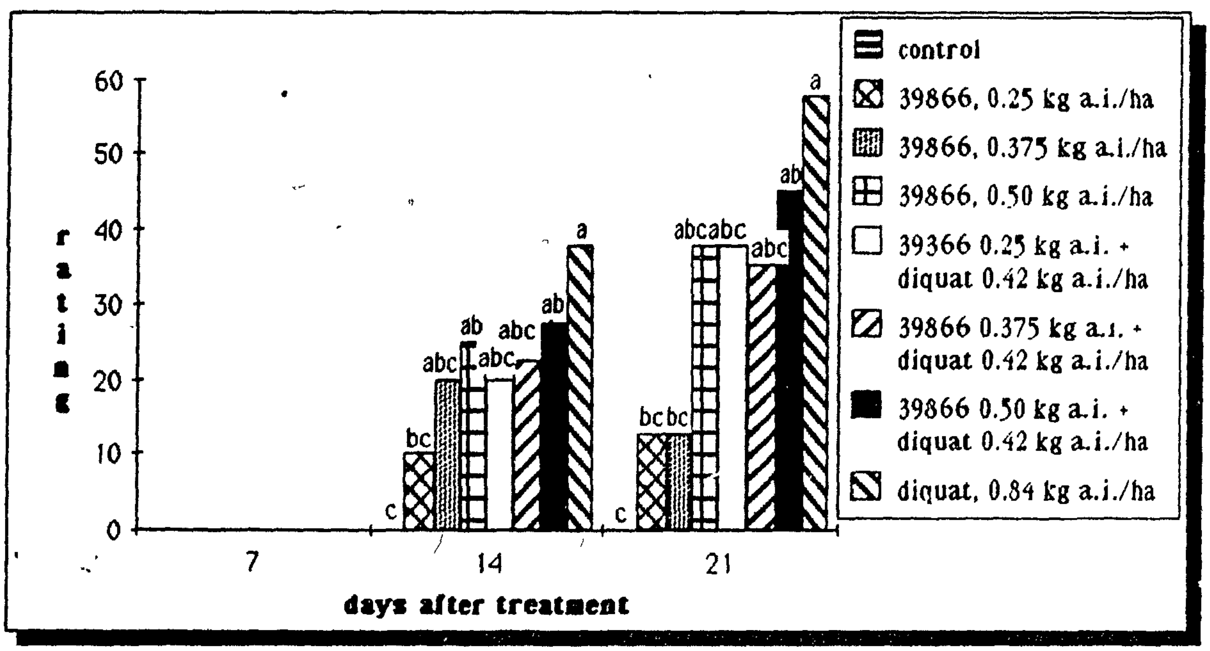


Fig 3.6 Leaf desiccation with Hoe-39866 alone and combined with diquat on the variety Sebago - Results of the 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate

3.3.1.2 Stem desiccation

The complete analyses using the Friedman test are presented in Appendix 14 There was a significant effect of the different desiccant treaments on each of the three cultivars; with the exception of Sebago, 7 days after desiccant application in 1986. In order to locate differences in desiccation performance, a multiple comparison test was performed using ranked visual ratings (experimentwise error rate = 25 %, except for Kennebec and Russet Burbank 7 days, 1986: experimentwise error rate = 40 %) (Figure 3.7 to 3.12).

The two lowest rates of Hoe-39866 of 0.25 and 0.375 kg a.i./ha resulted, to some extent, in a slower desiccation on each of the three cultivars in both 1985 and 1986 This low performance was observed to be significantly different from the standard diquat treatment only on Sebago and only for certain periods of data collection (i e 1985: 14 days after treatment and 1986: 21 days after treatment).

Hoe-39866, when used at 0.50 kg a.i./ha, was comparable to diquat in terms of desiccation performance (7, 14 and 21 days after desiccant application). This characteristic was observed on each of the three varieties in both 1985 and 1986

The addition of 0 42 kg a.i./ha of diquat to the low rates of Hoe-39866 substantially improved the desiccating performance of these treatments. This characteristic was noted on the three cultivars and for the two years of data collection. This enhancement was particularly noticeable on the cultivars Kennebec and Russet Burbank, 7 and 14 days after desiccant application; but on Sebago, the improvement was still appreciable 21 days after desiccant application for both the 1985 and 1986 set of data.

When comparing results between years, stem desiccation of the cutivars Kennebec and Russet Burbank was non existant 7 days after desiccant application in 1986. Fourteen days after treatment, all treaments showed better desiccation in 1986 Similar results between years, were obtained 21 days after desiccant application.

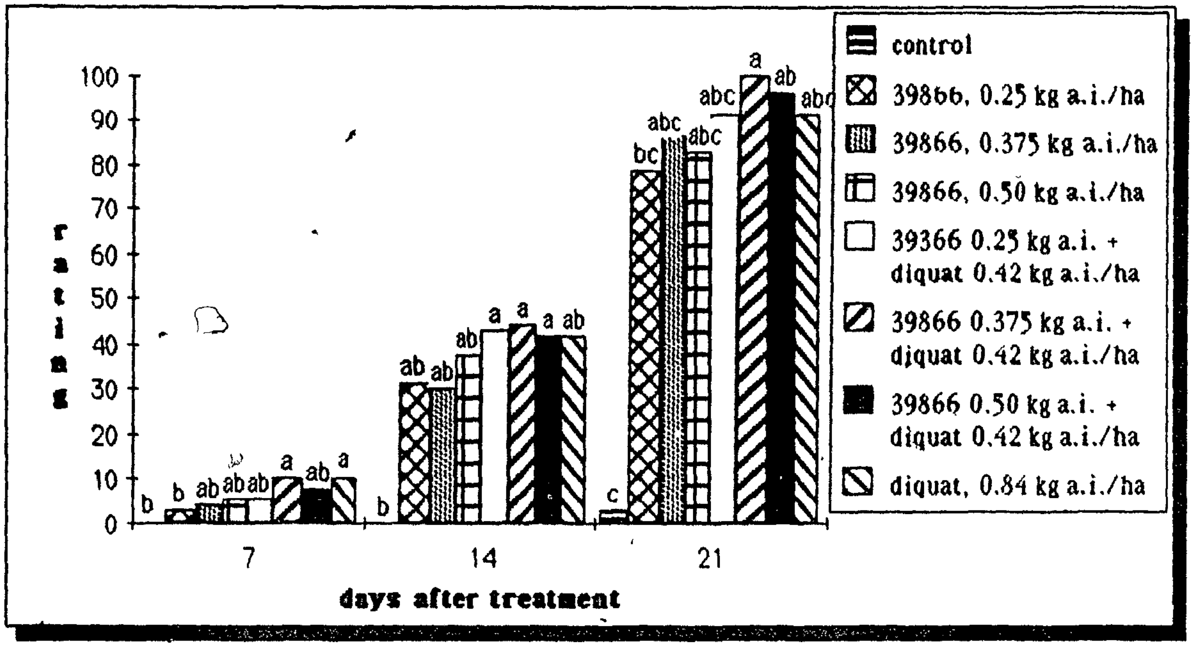


Fig 3.7 Stem desiccation with Hoe-39866 alone and combined with diquat on the variety Kennebec - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate.

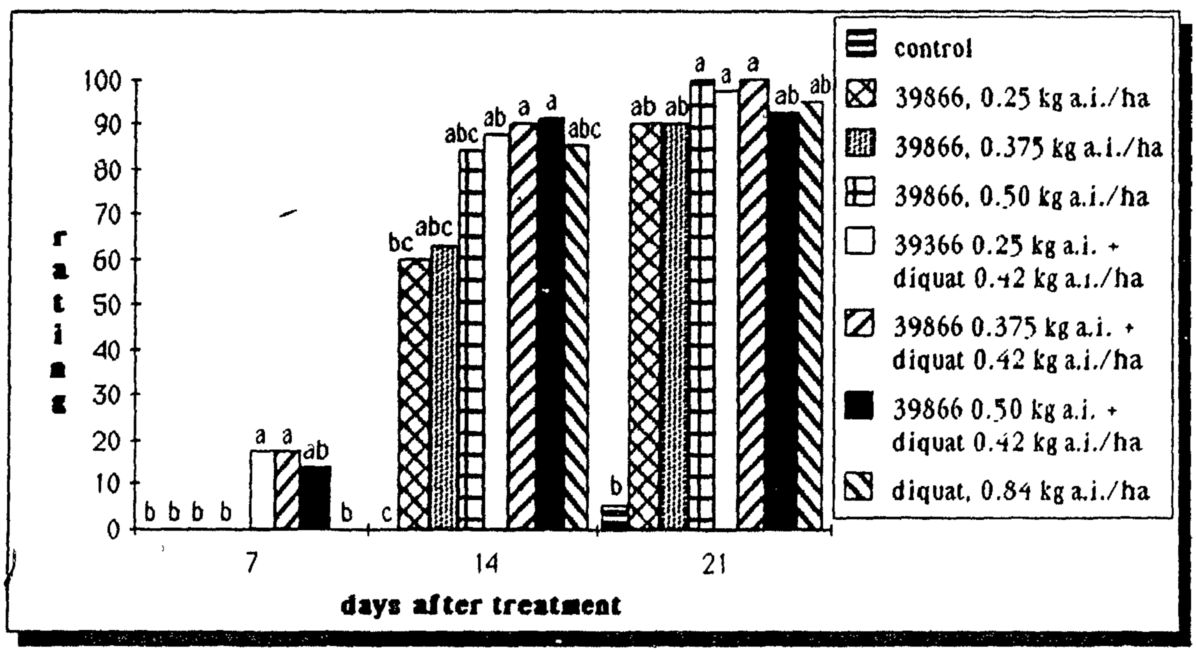


Fig 3.8 Stem desiccation with Hoe-39866 alone and combined with diquat on the variety Kennebec - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate (except for 7 days: error rate = 40%)

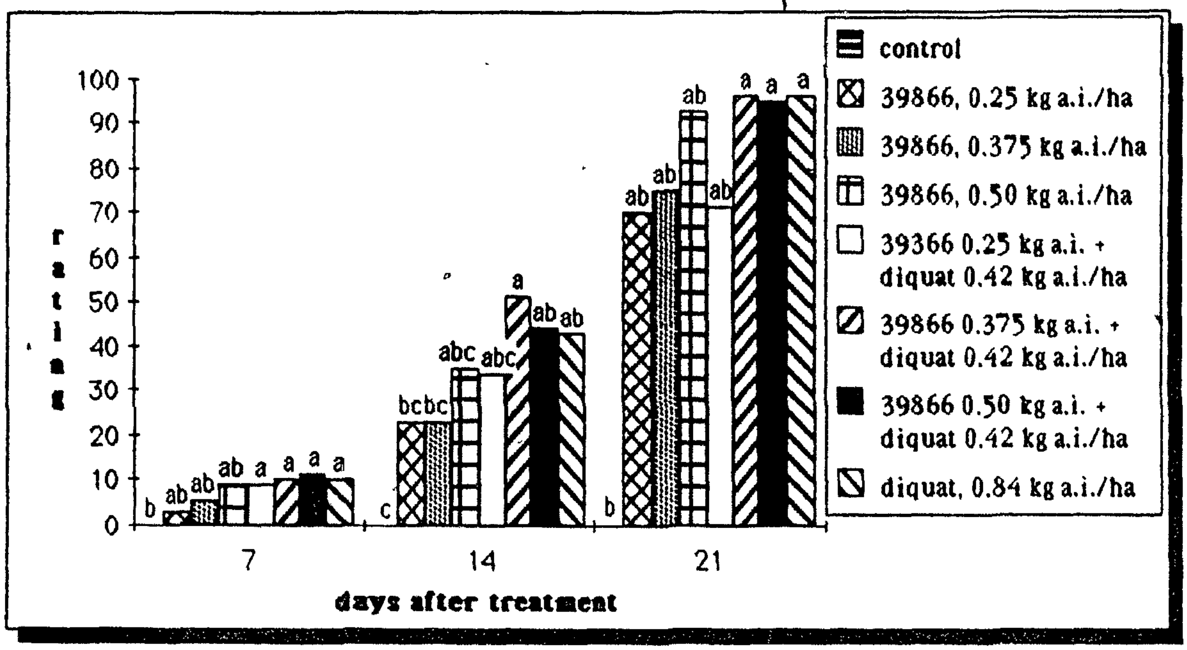


Fig 3.9 Stem desiccation with Hoe-39866 alone and combined with diquat on the variety Russet Burbank - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate.

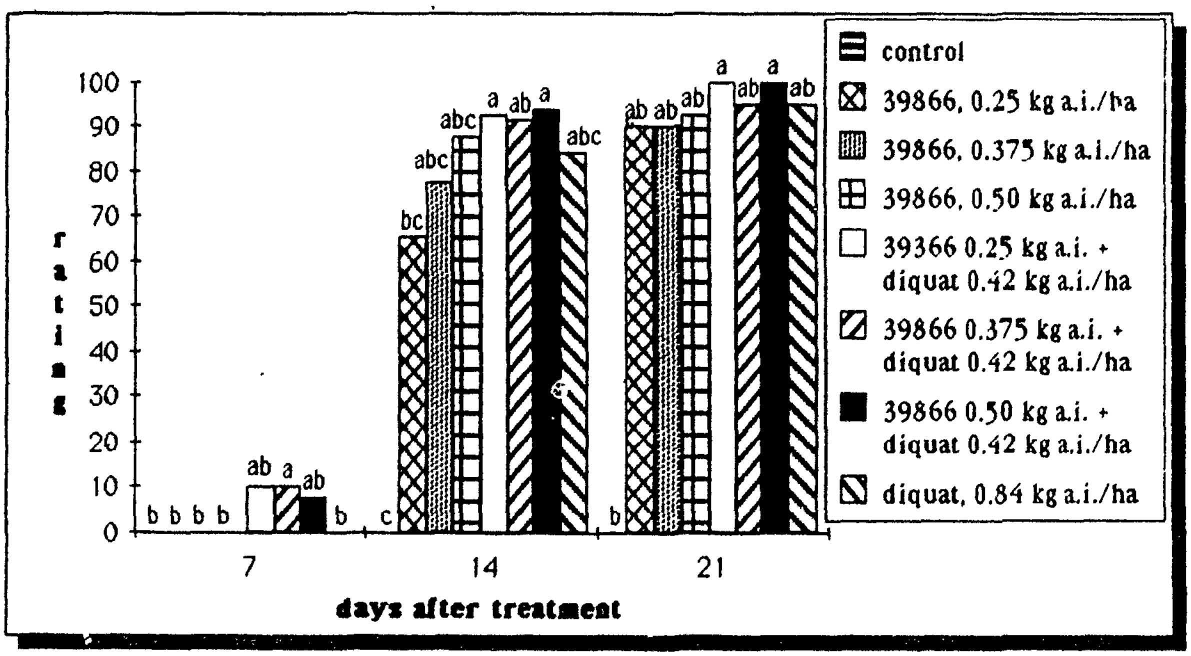


Fig 3.10 Stem desiccation with Hoe-39866 alone and combined with diquat on the variety Russet Burbank - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate (except for 7 days: error rate = 40%)

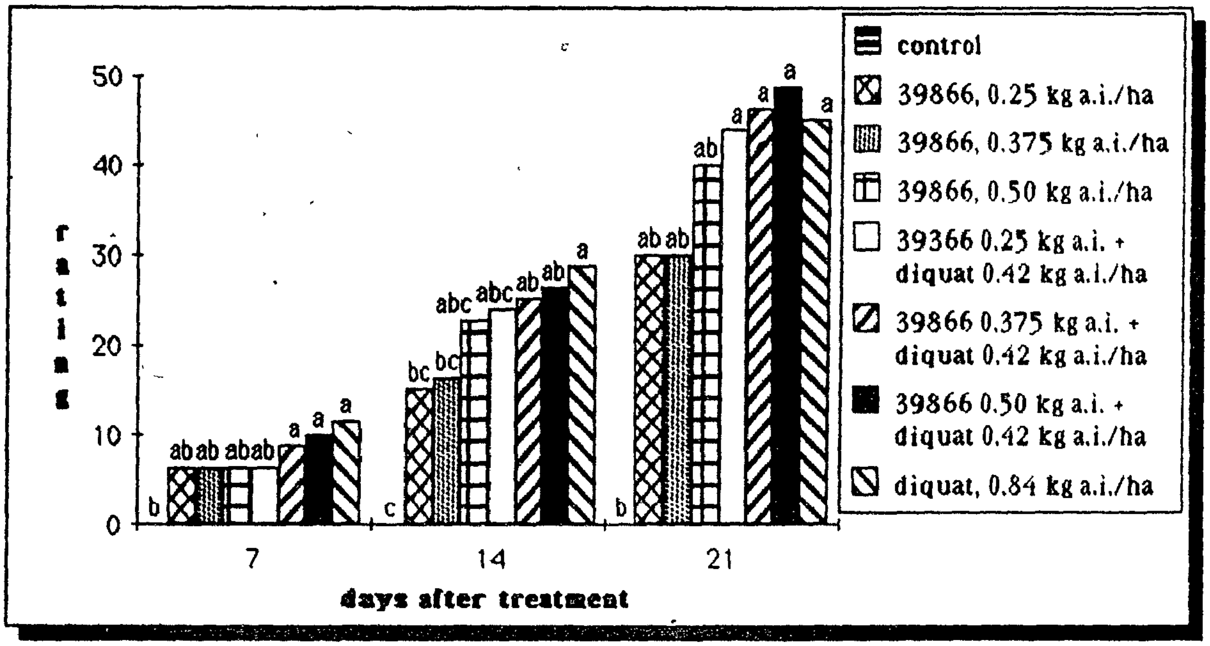


Fig 3.11 Stem desiccation with Hoe-39866 alone and combined with diquat on the variety Sebago - 1985 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate.

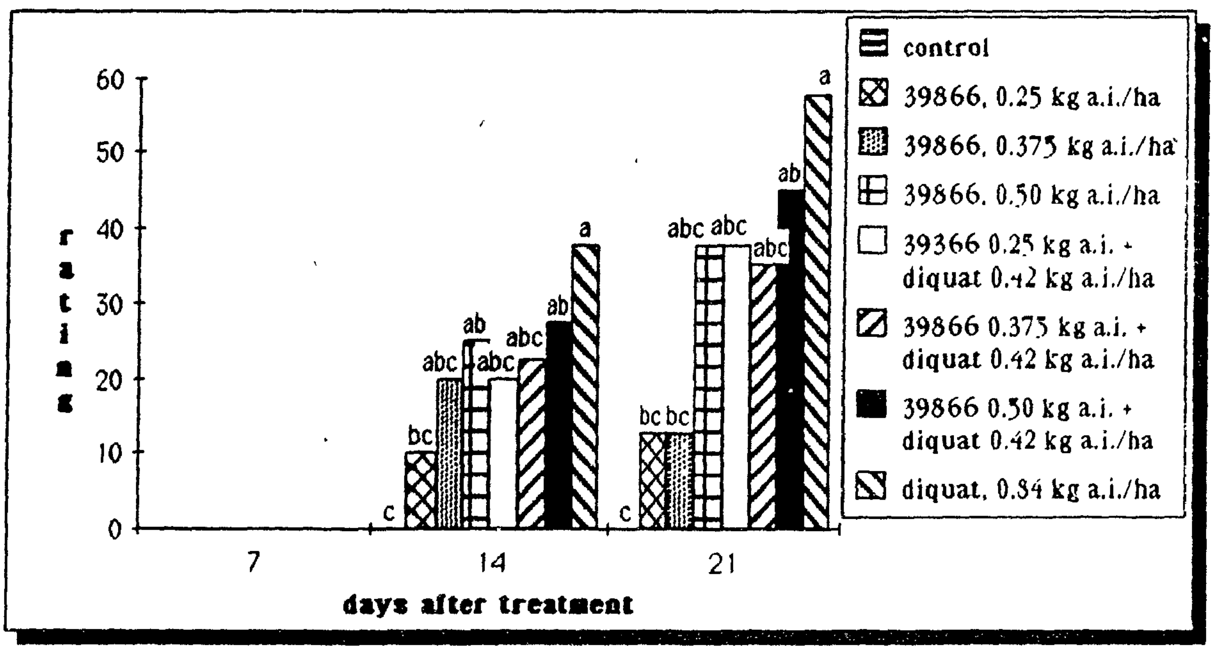


Fig 3.12 Stem desiccation with Hoe-39866 alone and combined with diquat on the variety Sebago - 1986 experiment. Columns identified with the same letter within each date are not significantly different at the 25% experimentwise error rate.

3.3.2 Tuber yield

Analyses of variance were performed on graded and total tuber yield of each of the three cultivars in order to determine if the desiccant treatments affected tuber yield. The analyses were done for both the 1985 and 1986 harvests. The complete analyses are presented in Appendices15a to 15f.

When variances were homogeneous between the two years the data from both years were combined and the analysis of variance performed on these combined data. The complete analyses are shown in Appendice 16. When considering these combined data, there was no significant effect of desiccant treatment on tuber yield for the three varieties. When considering single year data, significant effect of desiccation on tuber yield was observed only once (i.e. Sebago, size D, 1986 data). For this set of data, diquat at 0.84 kg a.i./ha, Hoe-39866 at 0.50 kg a.i./ha, Hoe-39866 + diquat at 0.25 + 0.42 kg a.i./ha and Hoe-39866 + diquat at 0.375 + 0.42 kg a.i./ha significantly decreased the yield of tubers when compared to untreated plants.

3.3.3 Stem end browning

A Friedman test was performed for both the 1985 and 1986 desiccation experiment in order to determine if desiccation with Hoe-39866 and diquat had any effect on stem end browning of harvested tubers. The complete analyses are presented in Appendix 17.

A multiple comparison test (experimentwise error rate = 25%) was performed in order to locate difference between the extent of stem end browning under the different desiccant treatments. From this test it was noted, for all the experiments, that there was no significant difference between the desiccant treatments in terms of their contribution to stem end browning.

3.3.4 Regenerative potential of tubers

3.3.4.1 Time of emergence and yield of plants grown from retained tubers

3.3.4.1.1 Time of emergence

An analysis of variance was performed for each of the three cultivar in order to determine if the emergence of plants grown from retained tubers was affected by the desiccation treatments. The completed analyses are listed in Appendix 18 There was no significant effect of the desiccant treatments on emergence of any of the three cultivars. This trend occurred for both the 28 and 42 day readings (Appendix 18).

3.3.4.1.2 Yield of tubers

An analysis of variance was performed for each of the three cultivars in order to determine if the yield of tubers of plants grown from retained tubers was affected by chemical desiccation treatment. The complete analyses are listed in Appendix 19. There was no significant effect of desiccant treatment on total yield of all the three cultivars under study.

3.3.4.2 Sprouting of tubers retained from desiccated plants

Analyses of variance were performed on the sprout length and weight of tubers retained from desiccated plants for each of the three cultivars in order to determine if the desiccant treatments affected sprout growth. The analyses were done for both the 1986 and 1987 experiments. The complete analyses are presented in Appendices 20 a to 20 f.

Sprout length was not affected to a significant degree by the desiccant treatments in the year 1986 (Figure 3.13 to 3.15). This was observed for the three varieties, except for the sprout length at 14 days of Kennebec. For this last set of data, sprout length under the standard diquat treatment was significantly higher than any of the other treatments including the untreated control (Table 3.2). Sprout fresh weight was not affected by desiccation, except for the fresh weight (28 days) of Kennebec. For this set of data, sprout fresh weight showed the same trend as of sprout length (14 days) of the same cultivar (Table 3.2). Finally sprout dry weight for the three cultivars was not affected by any of the desiccating treatments (Figure 3.16 to 3.18).

Table 3.2 Sprout length (14 days) and sprout fresh weight (28 days) of retained Kennebec tubers, 1986 experiment

Treatment	Rate (kg a.i./ha)	Sprout length 14 days (mm)	Sprout fr. weight 28 days (gr)
1. diquat	0.84	44.33 a	6.67 a
2. Hoe-39866	0.25	34.50 b	5.74 ab
3. Hoe-39866	0.375	37.83 b	4.03 b
4. Hoe-39866	0.50	33.50 b	3.88 b
5. Hoe-39866 + diquat	0.25 + 0.42	33.83 b	4.30 b
6. Hoe-39866 + diquat	0.375 + 0.42	37.67 b	5.92 ab
7. Hoe-39866 + diquat	0.50 + 0.42	36.92 b	5.47 ab
8. Control	-	34.17 b	5.34 ab

Numbers identified with the same letter, within each column are not significantly different at the 5% level (Duncan's multiple range test).

In 1987 sprout length at 14, 21 and 28 days was affected by desiccation for all of the three cultivars. Where response was observed, a general pattern of sprout length under the different treatments was observed (Figure 3.13 to 3.16). Reduction of sprout length was particularly evident for three of the desiccation treatments (i.e. Hoe-39866 at 0.375 and 0.50 kg a.i./ha and diquat at 0.82 kg a.i./ha). Finally the addition of 0.42 kg a.i. of diquat to the two highest rates of Hoe-39866 greatly reduced the inhibition of the latter desiccant on sprout length. Effect of desiccation on sprout fresh and dry weight, even if similar to that on sprout length, was not as consistant, being significant only on fresh weight of both Kennebec and Sebago and on dry weight of Kennebec. Effect of the different desiccation treament on sprout dry weight is shown in Figure 3.16 to 3.18.

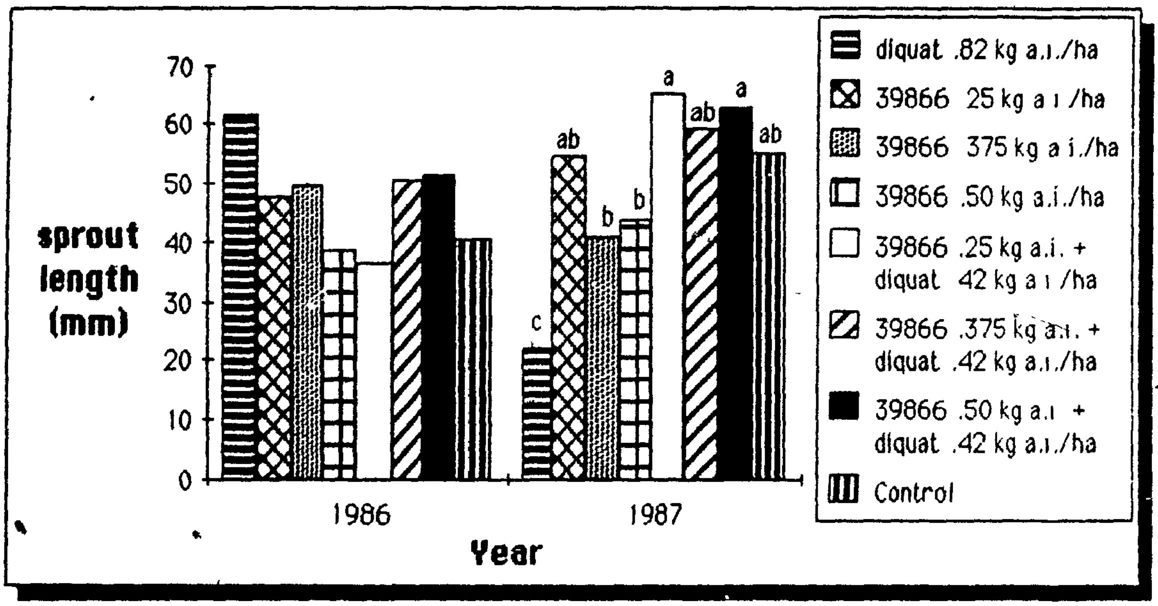


Fig. 3.13 Effect of Hoe-39866 used alone and in combination with diquat on the sprout length (21 days) of retained Kennebec tubers. Columns identified with the same letters within each date are not significantly different at the 1% level (Duncan's multiple range test).

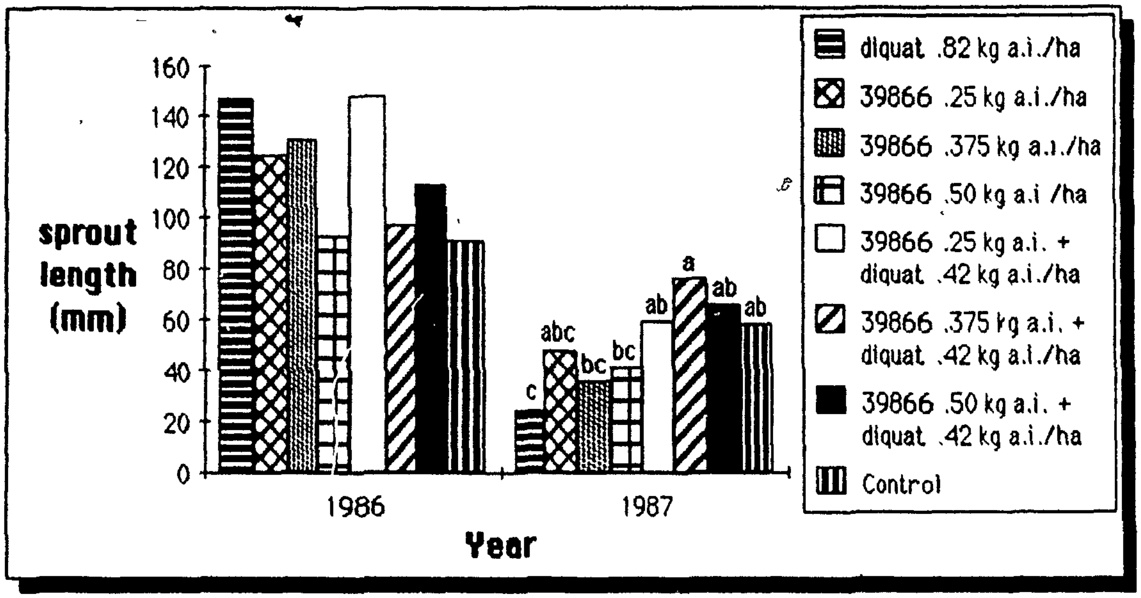


Fig. 3.14 Effect of Hoe-39866 used alone and in combination with diquat on the sprout length (21 days) of retained Russet Burbank tubers. Columns identified with the same letters within each date are not significantly different at the 5% level (Duncan's multiple range test).

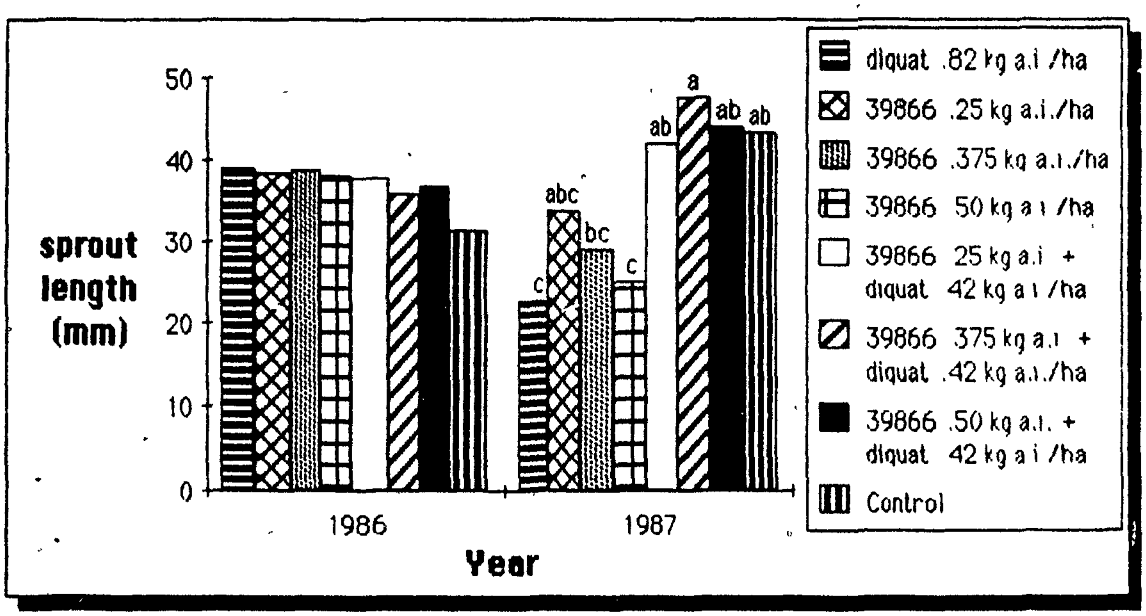


Fig. 3.15 Effect of Hoe-39866 used alone and in combination with diquat on the sprout length (21 days) of retained Sebago tubers. Columns identified with the same letters within each date are not significantly different at the 1% level (Duncan's multiple range test).

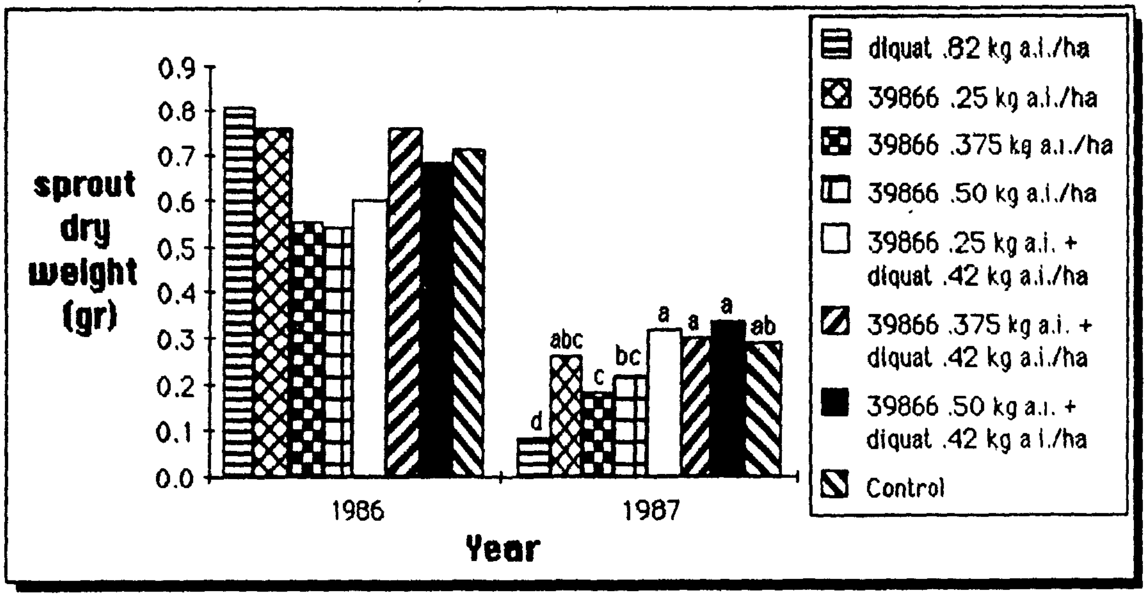


Fig. 3.16 Effect of Hoe-39866 used alone and in combination with diquat on the sprout dry weight (28 days) of retained Kennebec tubers. Columns identified with the same letters within each date are not significantly different at the 1% level (Duncan's multiple range test).

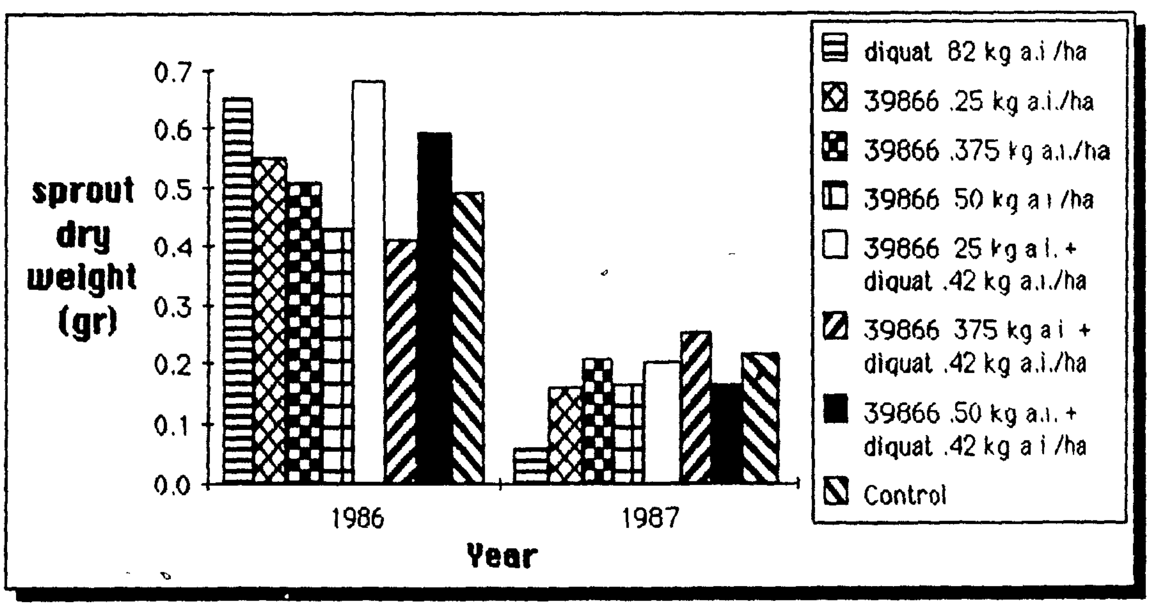


Fig. 3.17 Effect of Hoe-39866 used alone and in combination with diquat on the sprout dry weight (28 days) of retained Russet Burbank tubers.

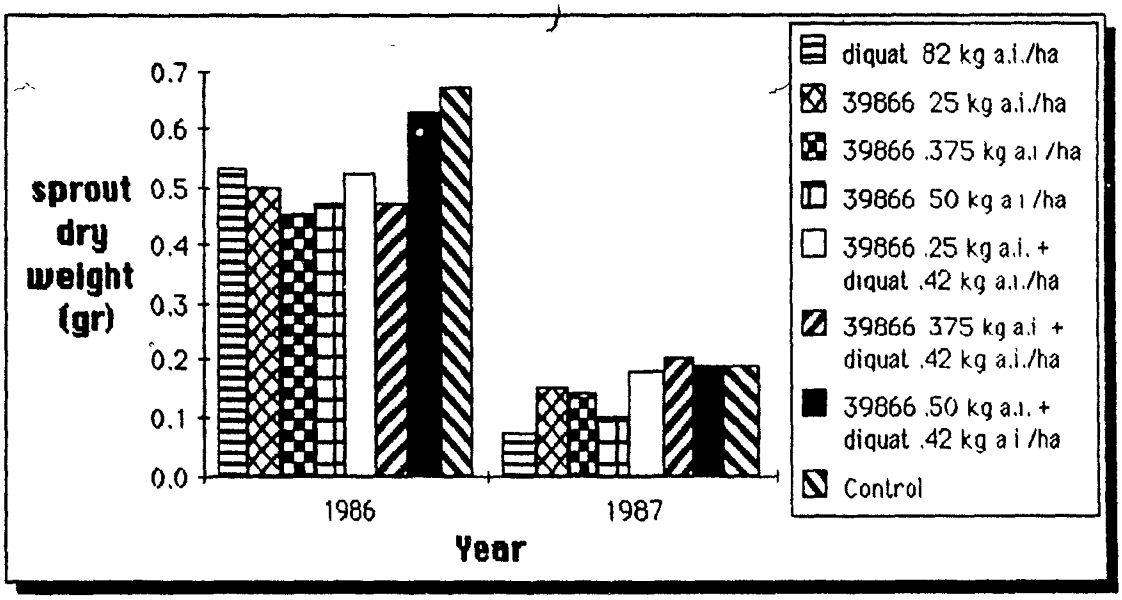


Fig. 3.18 Effect of Hoe-39866 used alone and in combination with diquat on the sprout dry weight (28 days) of retained Sebago tubers.

3.4 Discussion

3.4.1 Desiccation performance

3.4.1.1 Leaf desiccation

Leaf desiccation with Hoe-39866 used at 0.25, 0.375 and 0.50 kg a.i./ha, even if slower than under the standard diquat treatment, is acceptable and achieved adequate desiccation, 21 days after application, on both the cultivar Kennebec and Russet Burbank. On the cultivar Sebago, Hoe-39866 used at 0 25 kg a.i /ha did not provide acceptable desiccation Used at 0.375 kg a.i./ha, Hoe-39866 gave desiccation comparable to diquat at 0.82 kg a.i./ha but only in 1985. This decreased performance of Hoe-39866 in 1986, may have been due to difference in climatic conditions (section 1.2.7), and therefore this rate, along with the 0.25 kg a.i./ha rate are unacceptable as vine-killing treatments for this particular variety. On the same cultivar, Hoe-39866 used at 0 50 kg a.i./ha provided desiccation comparable to the standard diquat treatment, but still had visual ratings much lower than under the latter treatment, making its use questionable.

Adding 0.42 kg a.i./ha of diquat to the three rates of Hoe-39866 used, was effective in improving both the rapidity and adequacy of leaf desiccation on the three varieties of potatoes, making these three treatments acceptable for vine desiccation purposes. This increase in response may have been due to the rapid initial desiccation caused by diquat, as noted on all three cultivars.

3.4.1.2 Stem desiccation

As observed for leaf desiccation, stem desiccation with Hoe-39866 used alone was not as rapid as with the standard diquat treatment. The two lowest rates of Hoe-39866 of 0.25 and 0.375 kg a.i./ha, even if not significantly different from the diquat treatment on Kennebec and Russet Burbank, resulted in lower visual ratings and especially in 1985. These lower ratings makes their adequacy questionable in terms of desiccation performance. However Hoe-39866 used at 0.50 kg a.i./ha provided a good general stem desiccation on these two cultivars. On the cultivar Sebago, Hoe-39866 at 0.25 and 0.375 kg a.i./ha did not provide acceptable level of desiccation in 1986, making these two treatments unacceptable for stem desiccation purposes. On the same cultivar, Hoe-39866 used at 0.50 kg a.i./ha provided desiccation comparable to the standard diquat treatment, but still had visual ratings much lower than under the latter treatment, making its use questionable

Implementing these three rates of Hoe-39866 with diquat at 0 42 kg a.i /ha, was effective in improving the rapidity of stem desiccation on the three cultivars for the same reasons as those stated in section 3.4.1.1. These three treatments provided desiccation comparable to diquat and were generally more effective than when Hoe-39866 was used alone, making these three treatments acceptable in terms of desiccation performance.

3.4.2 Tuber yield

Tuber yield was not affected by the different desiccation treatments, except for Sebago large tubers (76-80 mm), 1986 experiment. Since desiccation was done before normal vine maturity, this reduction in yield is in accordance with the findings of Murphy (1968).

3.4.3 Stem-end discoloration

There was no significant effect associated with chemical desiccation on stem-end discoloration. These observations are in accordance with the findings of Hoyman (1947).

3.4.4 Regenerative potential of tubers

3.4.4.1 Time of emergence and yield of plants grown from retained tubers

3.4.4.1.1 Time of emergence

From the results obtained, it was noted that there was no significant effect of any of the desiccant treatments on emergence of plants grown from retained tubers This observation suggests no residual effects of the desiccation treatments on tubers of treated plants.

3.4.4.1.2 Yield of tubers from plants grown from retained tubers

There was no significant effect of the different desiccation treatments on yield of plants grown from retained tubers. This observation implies that there was no appreciable inhibition activity of any of the desiccant treatments on the yield potential of retained tubers.

3.4.4.2 <u>Sprouting of tubers retained from treated plants</u>

In general, the different desiccation treatments did not affect the sprouting ability of retained tubers to a significant extent However, increasing the rate of Hoe-39866 from 0.25 to 0.375 and 0.50 kg a.i./ha usually resulted in reducing both sprout length and sprout dry weight of retained tubers. Such an inhibition on sprout growth could have been the result of the partial systemic activity of Hoe-39866 (Kassebeer *et al.* 1983).

The combination of the three low rates of Hoe-39866 with diquat at 0.42 kg a.i./ha, generally resulted in minimizing the inhibition effect of Hoe-39866 on sprout length and weight of treated tubers. This response migth be due to the rapid contact action of diquat which could have limited, to some extent, the systemic activity of Hoe-39866.

Finally, in 1987, the standard diquat treatment resulted in lowering considerably sprout length and sprout dry weight of retained tubers when compared to the untreated control; a response completely opposite to that observed in 1986 where diquat did increase these two parameters for the three varieties studied. This reduction of sprouting performance in 1987 could have been caused by the drier conditions that have prevailed in the 1986 growing season (414 mm of rain in 1985 vs 312 mm of rain in 1986) This decreased rainfall might have reduced the germination potential of tubers treated with diquat (Ivany, personnal communication). And when we compare the sprout dry weight of 1987 to that of 1986, we can see that the sprouting performance of the tubers was noticeably reduced in 1987 for all the varieties and treatment combinations. This global reduction of sprouting in 1987 may be of importance and may have affect the germination potential under each desiccation treaments.

3.4.5 General discussion

Acceptable desiccation performances were obtained when Hoe-39866 was used at 0,50 kg a.i./ha for the two cultivars Kennebec and Russet Burbank. However at this rate, Hoe-39866 had some inhibition on the sprout growth of retained tubers and suggests some residual activity which could limit its use as a desiccant treament. The combination treatments of Hoe-39866 and diquat generally provided good desiccation without having any adverse effect on the germination potential of retained tubers.

Chapter 4

TRANSLOCATION AND ABSORPTION OF HOE-39866

IN POTATO PLANTS

4.1 Introduction

As reported in section 1.3 , Hoe-39866 provides good desiccation of potato haulms but it has the disadvantage of impairing the regenerative potential of tubers, which is an undesirable effect, especially for seed tuber production. This inhibition of seed vitality may be due, in part, to the translocation of Hoe-39866 and/or ammonia from the foliage to the tubers. Another factor which could be responsible for this inhibition may be the absorption of Hoe-39866 from the soil by the tuber itself.

Two experiments, using ^{14}C labeled Hoe-39866, were conducted in order to determine if the desiccant, or its metabolites, could be translocated either basipetally or acropetally in potato plants. Another experiment was also carried out in order to evaluate the absorption of Hoe-39866 through the skin and/or eyes of potato tubers

4 2 Material and methods

4.2.1 Translocation of Hoe-39866 in mature potato plants

4.2.1.1 Plant culture

Twenty seed tubers from the cultivar Kennebec were removed from storage and exposed to bromoethane (0.2 ml vapor/ml) in a desiccator for 24 hr on December 16th

1986. This method was shown to break dormancy and to favor sprouting as reported by Coleman (1983). Six days after the bromoethane treatment, ten tubers showing good germination were selected and planted in 30 cm pots containing a mixture of pro-mix, muck soil and sand (1:2:1). Pots were placed in greenhouse at a temperature of 20° C and exposed to a photoperiod of 16 hours. Under these conditions, plants showed excessive stolon elongation (aerial sprouts) which might have been due to extreme in temperature (Hiller et al, 1985). To correct this situation, temperature was lowered to 18° C and photoperiod reduced to 12 hours 40 days after planting to decrease stolon elongation and favor tuber formation.

Sixty five days after planting, five potted plants were selected on the basis of their uniformity of growth and moved to a fume hood. Four plants were treated with ^{14}C HOE-39866 labeled on carbon 3 & 4 (specific activity 5.26 KBq/microl or 0.142 microCi/microl). The ^{14}C HOE-39866 ammonium salt was obtained by dissolving the free acid in an equivalent amount of diluted ammonia. A 35 microlitre droplet (184 KBq or 4.97 microCi) was applied to the adaxial mid-portion of the adjacent leaflet to the terminal leaflet of a young fully expanded leaf (Figure 4.1). The treated leaf of all plants was the 5th leaf from the apex. The untreated plant was kept as a control.

After 7 days the plants were harvested and two of the treated plants were kept for liquid scintillation counting. After 14 days the same procedure was respected for the two remaining treated plants.

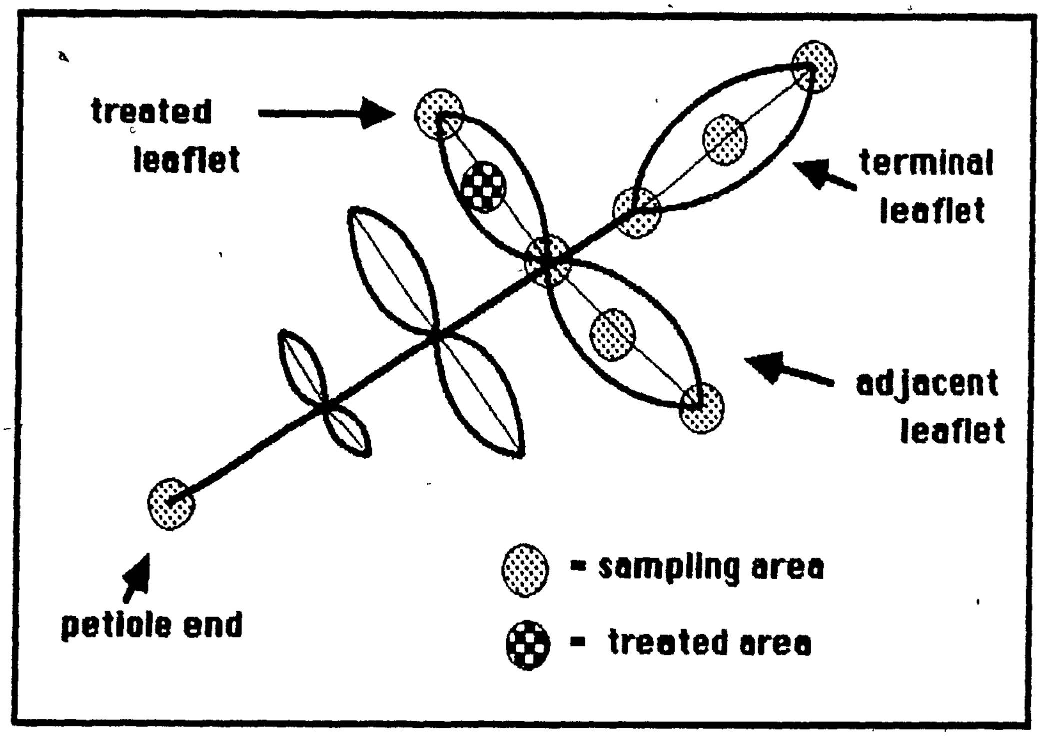


Fig. 4.1 Treated leaflet and sampling location.

4.2.1.2 Sample preparation and counting:

For every treated plant used in liquid scintillation counting, the same sampling procedure was followed. The treated leaf was separated into treated leaflet, adjacent leaflet and terminal leaflet. Treated leaflets were washed with 10 ml of water to remove the unabsorbed HOE-39866. A 0.5 ml aliquot of each washing solution was transferred to a liquid scintillation vial and 5 ml of liquid scintillation cocktail was added. Sampling on each of these leaflets was done at both the proximal and distal end of the leaflet and also in the median region of the leaflet. Sampling was also done at the petiole node located between the treated leaflet and adjacent leaflet. The proximal end of the treated leaf petiole was also sampled (Figure 4.1).

In addition, two apical meristems per plant and two tubers per plant were also assayed for radioactivity. The tuber samples were obtained from both the basal and the apical ends. Fresh weight of the tuber samples ranged between 5 and 10 mg.

Each sample was placed into a scintillation vial and 0.5 ml of a 1:2 30 % hydrogen peroxyde and 60 % perchloric acid was added to the vial. The vials were then placed into an oven at 65° C for 1 hour to allow for complete tissue solubilization. Five ml of liquid scintillation cocktail (universol cocktail) was added to the vials.

Each sample was counted for a period of five minutes in a liquid scintillation counter (LKB Wallac, 1219 Rackbeta 'Spectral'). A second counting for every sample was obtained 48 hours after the first count and the average reading was calculated.

4.2.2 Translocation of Hoe-39866 in apical potato cuttings

4.2.2.1 Plant culture

Ten Kennebec seed tubers were planted on June 1st 1987 in 30 cm pots containing a mixture of pro-mix, muck-soil and sand (1:2:1). Pots were placed in greenhouse with no additional lighting. Sixty-three days after planting, photoperiod was reduced to 8 hours, using black curtains, to enhance tuber formation (Ewing, 1978). After 10 days, 60 apical cuttings were obtained from the mother plants following the procedure described by Ewing (1978). The shoot apex was excised just below the forth node below the apex, counting the first node as the youngest one with a leaf at least 35 mm long. The basal leaf was excised and the cutting inserted to a depth of two cm in a ten cm pot containing a soil medium of equal amounts of sand and peat moss (Fig. 4.2). These cuttings were maintained on a mist bench at a temperature of 20° C and under a photoperiod of 21 hours. The cuttings were kept under these conditions for a period of 14 days.

Twelve apical cuttings were selected on the basis of vigor and good tuberization at the basal axillary bud. Selected cuttings were transferred to a fume hood and on the same day, nine cuttings were treated with ^{14}C Hoe-39866 (spec. act. 0,142 micro Ci). A 20 microl. droplet (2,84 microCi) was applied to the adaxial surface of the first leaf below the apex (Fig 4.2). Three untreated plants were kept as controls.

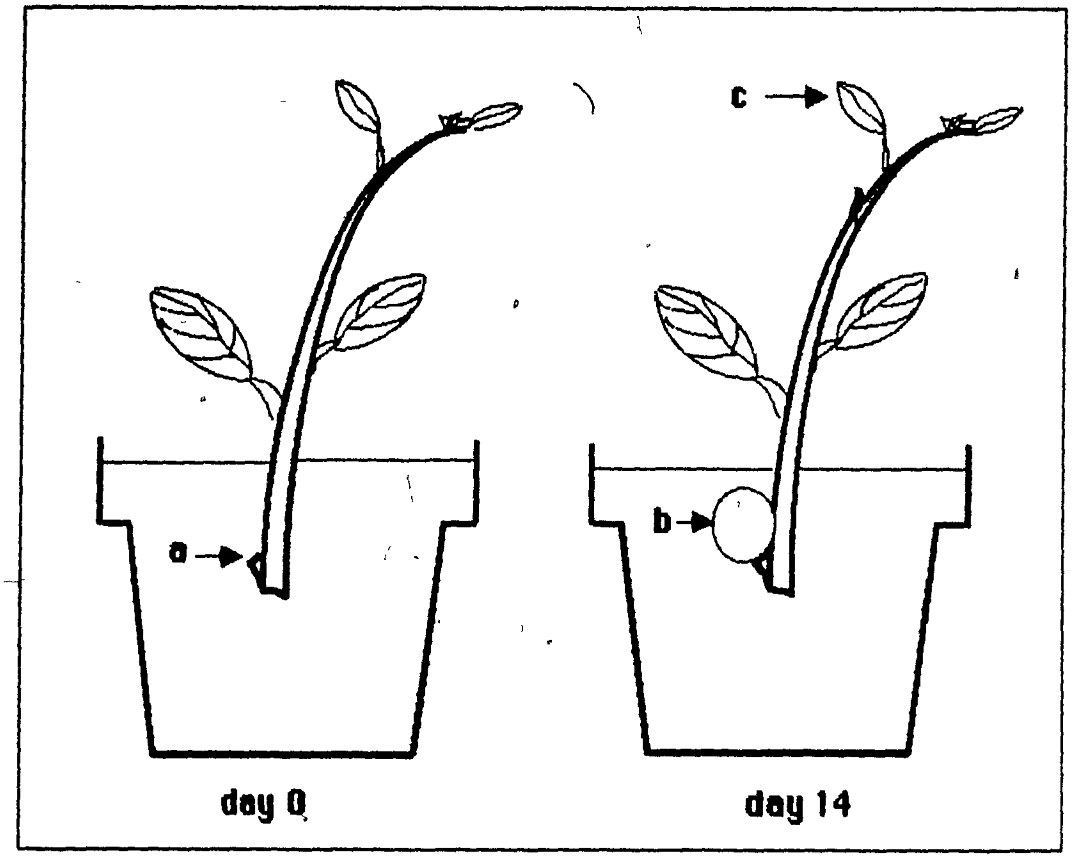


Fig. 4.2 Apical cuttings at day zero and after tuberization (day 14) along with treatment location. a) axillary bud. b) small tuber. c) treated leaf.

4.2.2.3 Sample preparation and counting

After 2, 4 and 7 days, three treated cuttings and one control cutting were harvested. On each cutting, both the meristem and tuber were excised Three tissue samples (weighing between 8 and 10 mg) were obtained from each of the meristem and from both the apical and basal end of each of the tuber. Tissue samples were solubilized using the procedure described in section 4.2.1.2 with tissues from the control cuttings treated similarly.

Each sample was placed into a scintillation vial and 0.5 ml of a 1:2 30 % hydrogen peroxyde and 60 % perchloric acid was added to the vial. The vials were then placed into an oven at 65° C for 1 hour to allow for complete tissue solubilization. Five ml of liquid scintillation cocktail (universol cocktail) was added to the vials. Each sample was coun-ted for a period of five minutes in a liquid scintillation counter (LKB Wallac, 1219 Rackbeta 'Spectral').

4.2.3 Absorption of Hoe-39866 by tubers

Sebago seed tubers (Elite III seeds) were dipped for 1 second in Hoe-39866 solutions of different concentrations [0 - 3333 ppm(v/v)] to evaluate any inhibitory effect of Hoe-39866 on the sprouting of treated tubers (Table 4.1). After treatment, tubers were placed, basal end down, in a randomized block design, on plastic trays previously half-filled with peat moss. The trays were then placed in controlled environment for a period of 28 days under complete darkness, relative humidity of 90 % and temperature of 20° C. Sprout length was recorded on three eyes per tuber after 14, 21 and 28 days. Fresh weight and dry weight of the sprout growth of the three eyes was recorded at the end of this experiment (after 28 days).

Table 4.1 List of treatments

Treatment	Concentration (ppm(v/v) of a.i)
1. Hoe-39866	3333
2. Hoe-39866	333
3. Hoe-39866	33
4. Hoe-39866	3
5. Hoe-39866	0.3
6. Hoe-39866	0.03
7. Hoe-39866	0.003
8. Control	0

4.3 Results

4.3.1 Translocation of Hoe-39866 in mature potato plants

4.3.1.2 Absorption of Hoe-39866

Absorption of the desiccant after 7 and 14 days are listed in Table 4.2. No increase in absorption was observed from 7 to 14 days after treatment time. In fact the plant harvested 14 days after desiccant application showed a lower retention of the labelled desiccant.

Table 4.2 Absorption of ^{14}C Hoe-39866 into leaves of potato plants.

	activity in KBq [a]	
	7 days after	14 days after
	Mean +/- S.D.	Mean +/- S.D
Applied activity	184.00 +/- 5.53	184.00 +/- 5.5
Activity in rinse water	82.94 +/- 6.77	115.33 +/- 16.45
Absorption %	54.92 +/- 4.48	37 32 +/- 5.32

[a] all values listed in the table are averages of six samples counted twice.

4.3.1.3 Translocation of Hoe-39866 into treated leaf

Presence of radiolabeled Hoe-39866 or its metabolites was observed at both the distal and proximal end of the treated leaflet. Much higher activity (in all 4 plants) was recorded at the distal end (Table 4.3). This higher activity could have been due to improper washing of the treated leaflet. Since rinsing of the leaflet was done from the proximal end to the distal end and since only 10 ml of water was used, it is possible that some unabsorbed ^{14}C -HOE-39866 accumulated at the distal end of the leaflet. All sampling locations however were much higher in activity than the control samples used as a background reference.

Table 4.3 Recovered activity of ^{14}C Hoe-39866 in treated leaf

		activity recovered (Bq/mg fresh weight) [a]	
		7 days	14 days
Adjacent leaflet	Proximal	0.13 +/- 0.10	0.45 +/- 0.17
	Mid	0.07 +/- 0.14	0.03 +/- 0.02
	Distal	0.05 +/- 0.06	0.05 +/- 0.05
Treated leaflet	Proximal	0.83 +/- 0.77	4.88 +/- 3.68
	Mid	10.22 +/- 8.00	53.85 +/- 23.07
	Distal	26.42 +/- 25.77	93.49 +/- 28.86
Terminal leaflet	Proximal	0.05 +/- 0.04	0.15 +/- 0.09
	Mid	0.01 +/- 0.02	0.02 +/- 0.01
	Distal	0.07 +/- 0.13	0.11 +/- 0.10

[a] all values listed in the table are averages of six samples counted twice. Background activity = 0.01 +/- 0.02 Bq/mg fresh weight.

Activity was also recorded in samples of the petiole between the treated leaflet and the leaflet facing it (adjacent leaflet). This activity was noted in all plants (Table 4.4). Distribution of radioactivity in the leaflet facing the treated leaflet seemed to decreased from the proximal end to the distal end. However this observation was not observed for all 4 plants (Table 4.3). Some radioactivity could also be found into the terminal leaflet but at lower levels when compared to the two other leaflets (Table 4.3). It was also noticed, in all 4 plants, that radioactivity moved to the proximal end of the leaf petiole at levels that were 6.5 to 16 times higher than the background activity found in the control plants (Table 4.4).

Table 4.4 Recovered activity of ^{14}C Hoe-39866 ot leaflet internode and petiole end

	activity recovered (Bq/mg fresh weight) [a]	
	7 days	14 days
Leaflet internode	0.38 +/- 0.38	0.58 +/- 0 34
petiole end	0.13 +/- 0.07	0.11 +/- 0.06

[a] all values listed in the table are averages of six samples counted twice
Background activity = 0.01 +/- 0.02 Bq/mg fresh weight.

4.3.1.4 Translocation of Hoe-39866 into meristems and tubers

Only low levels of activity were recorded in meristems of treated plants Some activity could be detected at the apical end of the tubers at both 7 days and 14 days after treatment but no appreciable amount of radioactivity could be found at the basal end of the tubers (Table 4.5).

Table 4.5 Recovered activity of ^{14}C Hoe-39866 in meristems and tubers

	activity recovered (Bq/mg fresh weight) [a]	
	7 days	14 days
Meristem	0.08 +/- 0.08	0.06 +/- 0.05
Tuber apical end	0.04 +/- 0.08	0.02 +/- 0.08
Tuber basal end	0.02 +/- 0.02	0.01 +/- 0.02

[a] all values listed in the table are averages of 12 samples counted twice.
Background activity for meristem = 0.002 +/- 0.003 Bq/mg fresh weight.
Background activity for tuber = 0.023 +/- 0.028 Bq/mg fresh weight.

4.3.2 Translocation of Hoe-39866 in apical potato cuttings

4.3.2.1 Translocation to meristems

Presence of ^{14}C Hoe-39866 (or its metabolite) in apical meristems of potato cuttings was detectable at all sampling periods. An appreciable increase in activity was observed between 2 and 4 days after desiccant application. No such increase could be observed between the 4 and 7 days sampling period (Table 4.6).

4.3.2.2 Translocation to tubers

Presence of labeled Hoe-39866 (or its metabolite) in tubers was detected in both the basal and apical end of tubers(Table 4.6). An appreciable increase in activity was observed between 2 and 4 days after desiccant application. No such increase was observed between the 4 and 7 days sampling period. No conclusive difference in radioactivity could be detected between the apical and basal ends of tuber (Table 4 6).

Table 4.6 Recovered activity of ^{14}C Hoe-39866 in meristem and tuber of apical cuttings.

	activity recovered (Bq/mg fresh weight) [a]		
	2 days	4 days	7 days
Meristem	0.06 +/- 0.06	159.09 +/- 243.30	79.81 +/- 160.40
Tuber apical end	0.19 +/- 0.07	0.76 +/- 0.96	0.80 +/- 1.66
Tuber basal end	0.08 +/- 0.06	1.17 +/- 1.09	0.58 +/- 0.76

[a] all values listed in the table are averages of nine samples
Background activity for meristem = 0.03 +/- 0.01 Bq/mg fresh weight.
Background activity for tuber = 0.04 +/- 0.001 Bq/mg fresh weight.

4.3.3 Absorption of Hoe-39866 by tubers

Analyses of variance were performed on the sprout length and weight of tubers dipped in solutions of different concentration of Hoe-39866 in order to determine if any of these treatments affected sprout growth. The complete analyses of the two experiments are presented in Appendices 22a and 22b with the combined analysis in Appendice 23. There was a significant effect of desiccant treatment on the sprout length for both runs. Analysis of combined data could not be performed on both fresh and dry weight readings, however it was observed that the treatments had a significant effect on these variables in both experiments

A regression analysis was performed on the combined data (except fresh and dry weight) of each of the three cultivars, with sprout length as a function of Hoe-39866 concentration in ppm(v/v) (Appendix 24). From these analyses the degree of the polynomials describing the data were found and are presented in Table 4.7. Regression analysis was also performed on the separate data of both fresh and dry weight and regression equations obtained are presented in Table 4.8.

From these regression equations it was noted that sprout length and sprout weight of Sebago tubers was negatively correlated to the concentration of Hoe-39866 used. The regression equations with the highest coefficient of determination were kept to draw regresion lines (Figure 4.3 and 4.4). Sprout length and fresh weight was found to be significantly different from that of the control at concentration 3333 ppm v/v

Table 4.7 Regression equations of sprout length of tubers as affected by Hoe-39866 concentration. Combined data.

Number of days	Regression equation	R^2	C.V.	Pr > F
7	$Y = 16.51 - 2.61 \times 10^{-3} H$	0.28	30.54	0.0001
14	$Y = 34.64 - 7.03 \times 10^{-3} H$	0.47	26.35	0.0001
21	$Y = 38.64 - 7.45 \times 10^{-3} H$	0.51	22.87	0.0001
28	$Y = 39.21 - 7.26 \times 10^{-3} H$	0.46	24.09	0.0001

Where
- Y is the sprout length in mm
- H is Hoe-39866 concentration in ppm(v/v)
- R^2 is the coefficient of determination
- CV is the coefficient of variability in %
- Pr is the probability that the regression equation is due to chance only

Table 4.8 Regression equations of sprout weight of tubers as affected by Hoe-39866 concentration.

Dependent variable	Run	Regression equation	R^2	C.V.	Pr > F
fresh weight	1	$Y = 2.60 - 6.15 \times 10^{-4} H$	0.64	22.28	0.0001
fresh weight	2	$Y = 3.11 - 6.92 \times 10^{-4} H$	0.46	30.06	0.0001
Dry weight	1	$Y = 0.41 - 8.93 \times 10^{-5} H$	0.60	22.36	0.0001
Dry weight	2	$Y = 0.64 - 1.44 \times 10^{-4} H$	0.43	32.08	0.0001

Where

Y is the sprout weight in gr
H is Hoe-39866 concentration in ppm(v/v)
R^2 is the coefficient of determination
CV is the coefficient of variability in %
Pr is the probability that the regression equation is due to chance only

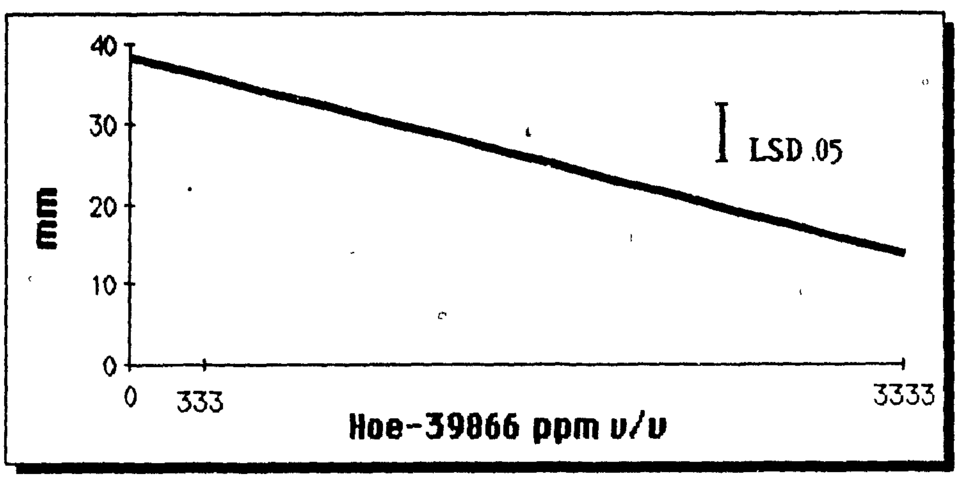


Fig 4.3 Sprout length of Sebago tubers (21 days) as affected by Hoe-39866 concentration.

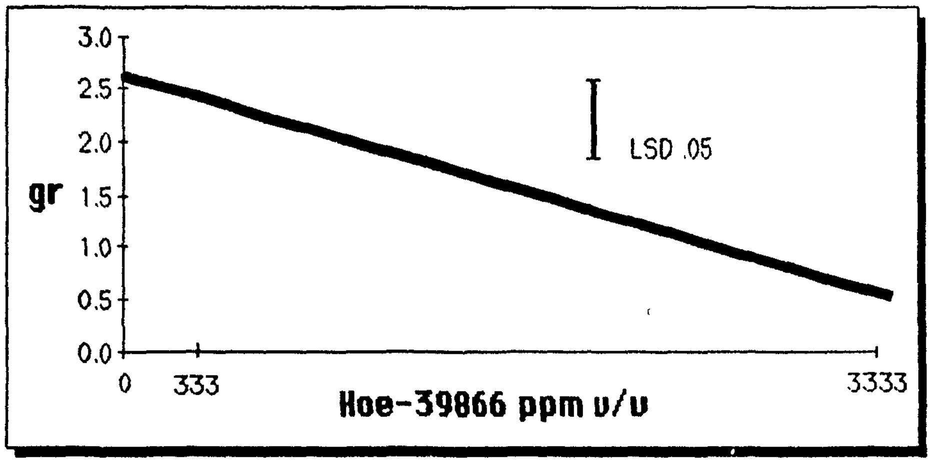


Fig 4.4 Sprout fresh weight of Sebago tubers(1st run) as affected by Hoe-39866 concentration.

4.4 Discussion

4.4.1 Translocation of Hoe-39866 in mature potato plants

4.4.1.2 Absorption of Hoe-39866

A reduction in absorption and/or retention of ^{14}C labelled Hoe-39866 could be noted between 7 and 14 days after application. This phenomenon can possibly be explained by the fact that the treated leaf tissue, 14 days after treatment, was completely dried out and may have permit leakage of the labelled desiccant out of the leaf tissue

4.4.1.3 Translocation of Hoe-39866 into treated leaf

The presence of radioactivity into the different parts of the treated leaf suggests the possible movement of ^{14}C Hoe-39866 or any of its metabolites out of the treated leaflet. The radioactivity found at the proximal end of the leaf petiole suggests that this movement may not be limited to the treated leaf and may extend out of the leaf vascular tissue

4.4.1.4 Translocation of Hoe-39866 into meristems and tubers

The detection of radioactivity in the meristems of treated potato plants indicates the possible acropetal movement of Hoe-39866 or of any of its metabolites. However, since the variability of the different readings was high (Table 4.5), the acropetal movement of Hoe-39866 can not be generalised to all the plants studied. The low levels of radioactivity found in the tubers, close to background activity, suggests some basipetal movement of the desiccant or its metabolites to the tubers. However the variability of the results, as well as the low levels, suggest further studies. The variation and low level of activity found was probably caused by the tremendous dilution factor associated with using large mature potato plants.

Such a dilution factor, using mature potato plants, suggests that more conclusive observations might be drawn if smaller individuals were used. By using smaller plants, this dilution factor would be reduced and movement of radioactive compounds would then be made easier

4.4.2 Translocation of Hoe-39866 in apical potato cuttings

4.4.2.1 Translocation to meristems

The presence of radioactivity in the meristems of treated potato cuttings suggests the acropetal movement of Hoe-39866 or its metabolites Accumulation of radioactive compound in the meristems occurs up to 4 days after treatment time However the variability of the results indicates that the acropetal movement of Hoe-39866 or its metabolites, even if possible, could be variable between treated individuals

4.4.2.2 Translocation to tubers

The detection of radioactivity in the tubers of treated potato cuttings suggests the possible basipetal translocation of Hoe-39866 or its metabolites. Accumulation of radioactive compounds in the tubers occurs up to 4 days after treatment. However, variability of the results suggests that this basipetal movement of Hoe-39866 or its metabolites, even if possible, would be variable between treated individuals. Finally there are no indications that the radioactive compounds preferably accumulates at the basal or apical end of the tuber

4.4.3 Absorption of Hoe-39866 by tubers

The negative correlation found between the concentration of Hoe-39866 solutions and the sprout growth of tubers dipped in these solutions, indicates the possible absorption of Hoe-39866 through the tuber epidermis or directly from the eyes of the tuber. Such an absorption would permit Hoe-39866 to express its herbicidal activity, which would explain the reduction of sprout growth ocurring under increasing Hoe-39866 concentrations.

4.5 General discussion

Radioactive studies have shown the possible acropetal and basipetal movement of Hoe-39866 or any of its metabolites in potato plants. However translocation was more conclusively demonstrated with small apical cuttings rather than in mature potato plants. Reduction of sprout growth from tubers dipped in solutions of Hoe-39866 suggested possible direct absorption of the desiccant by the tubers.

CHAPTER 5

SUMMARY AND CONCLUSION

Hoe-39866 was found to be a good desiccant in terms of both leaf and stem desiccation on the three cultivars Kennebec, Russet Burbank and Sebago. The use of Hoe-39866 as a desiccant did not increase the occurence of stem-end browning but did reduce, to some extent, the yield of large sized tubers for the three varieties studied. At rates that provided good desiccation, Hoe-39866 had an inhibiting effect on the regenerative potential of tubers that were retained from desiccated plants The inhibition was expressed by: a) a delayed emergence of treated plants, b) a reduction in both sprout length and sprout dry weight and c) a reduction in yield of plants obtained from these plants. This inhibition would limit the possible use of Hoe-39866 as a desiccant to table stock production only.

The combination of low rates of Hoe-39866 with diquat provided acceptable desiccation of potato tops, but without the deleterious effect of inhibiting the germination potential of retained tubers. Such treatments could then be used as desiccating treatments for both seed and table stock potato production since they do not affect seed tuber quality.

The inhibition effect observed on the germination potential of tubers retained from plants desiccated with Hoe-39866 could be the result of the basipetal translocation of the herbicide and/or any of its metabolites and/or toxic levels of ammonia from the treated top to the tubers. In fact, the radioactive studies performed in this research program, did demonstrate the possible acropetal and basipetal translocation of Hoe-39866 and/or its metabolites. However no experiments were performed to evaluate any basipetal movement of ammonia to the tubers. The possible basipetal translocation of Hoe-39866 to the tubers, suggests that more residual studies should be done before this product can be used as a desiccant for table stock potato production. Other factors which may contribute to the inhibition of germination potential are: a) absorption of Hoe-39866 through the tuber epidermis and b) lack of glutamine for amide transfer reaction. We did demonstrate the possible absorption of Hoe-39866 by the tubers, but no experiments were performed to evaluate the effect of using Hoe-39866 as a desiccant on the glutamine content of retained tubers.

The fact that the combination treatments of low rates of Hoe-39866 and diquat did not decrease the germination potential of retained tubers to significant levels could be due to the rapid contact action of diquat reduced the basipetal movement of Hoe-39866 or of its metabolites. This rapid action may also have reduced the accumulation of ammonia caused by Hoe-39866, which could play a role in the inhibition process However since translocation of Hoe-39866 is still possible with those particular treatments, further studies should evaluate the accumulation of this herbicide in the tubers before it is used for table stock potato production.

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APPENDICES

APPENDIX 1 a. Friedman test for leaf desiccation with Hoe-39866 and diquat. 1985 and 1986 results.

Cultivar	year	time	source	df	X_r^2	$Pr > X_r^2$
Kennebec	1985	7 days	desiccant treatment DS	4	15.44	**
"	"	14 days	DS	4	14.83	**
"	"	21 days	DS	4	13.52	**
"	1986	7 days	DS	4	16.00	**
"	"	14 days	DS	4	17.30	**
"	"	21 days	DS	4	14.43	**
Russet-Burbank	1985	7 days	DS	4	15.44	**
"	"	14 days	DS	4	13.53	**
"	"	21 days	DS	4	14.87	**
"	1986	7 days	DS	4	15.85	**
"	"	14 days	DS	4	15.52	**
"	"	21 days	DS	4	13.00	**
Sebago	1985	7 days	DS	4	15.85	**
"	"	14 days	DS	4	15.44	**
"	"	21 days	DS	4	15.85	**
"	1986	7 days	DS	4	16.00	**
"	"	14 days	DS	4	16.00	**
"	"	21 days	DS	4	16.00	**

Where

** is significant at 1% level

APPENDIX 1 b. Friedman test for stem desiccation with Hoe-39866 and diquat. 1985 and 1986 results.

Cultivar	year	time	source	df	X_r^2	$Pr > X_r^2$
Kennebec	1985	7 days	desiccant treatment DS	4	26.50	**
"	"	14 days	DS	4	14.29	**
"	"	21 days	DS	4	13.49	**
"	1986	7 days	DS	4	0	n.s
"	"	14 days	DS	4	15.79	**
"	"	21 days	DS	4	16.00	**
Russet-Burbank	1985	7 days	DS	4	14.89	**
"	"	14 days	DS	4	15.53	**
"	"	21 days	DS	4	14.50	**
"	1986	7 days	DS	4	16.00	**
"	"	14 days	DS	4	15.85	**
"	"	21 days	DS	4	16.00	**
Sebago	1985	7 days	DS	4	32.40	**
"	"	14 days	DS	4	15.64	**
"	"	21 days	DS	4	15.44	**
"	1986	7 days	DS	4	0	n.s.
"	"	14 days	DS	4	16.99	**
"	"	21 days	DS	4	15.85	**

Where
** is significant at 1% level
n.s. is not significant at the 5% level

APPENDIX 2 a. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on tuber yield of the variety Kennebec. 1985 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.0273	n.s.	41.52
	desiccant trt. DS	4	0.0852	n.s.	
	Error	12	0.1681		
B (41 -60 mm)	R	3	0.2328	n.s.	24.27
	DS	4	1.2671	n.s.	
	Error	12	3.9520		
C (61 -75 mm)	R	3	15.6228	*	15.52
	DS	4	1.2042	n.s.	
	Error	12	13.7998		
D (76 -80 mm)	R	3	12.1233	n.s.	14.24
	DS	4	14.5046	n.s.	
	Error	12	16.9340		
J (80 mm +)	R	3	3.5858	n.s.	48.84
	DS	4	27.6670	**	
	Error	12	13.1874		
Total yield	R	3	81.5744	*	11.24
	DS	4	84.1079	*	
	Error	12	60.8180		

Where
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 2 b. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on tuber yield of the variety Kennebec, 1986 results.

Tuber size	Source of variation	df	SS	Pr>F	C.V
A (0 -40 mm)	replication R	3	0.1323	n.s.	26.90
	desiccant trt. DS	4	0.2227	n.s.	
	Error	12	0.3754		
B (41 -60 mm)	R	3	2.8083	n.s.	9.82
	DS	4	2.0236	n.s.	
	Error	12	5.4244		
C (61 -75 mm)	R	3	4.2116	n.s.	8.61
	DS	4	1.3750	n.s.	
	Error	12	21.9037		
D (76 -80 mm)	R	3	2.1383	n.s.	33.76
	DS	4	13.2993	**	
	Error	12	7.2994		
J (80 mm +)	R	3	-	-	-
	DS	4	-	-	
	Error	12	-		
Total yield	R	3	5.8534	n.s.	4.80
	DS	4	14.0563	n.s.	
	Error	12	18.0263		

Where
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 2 c. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on tuber yield of the variety Russet Burbank. 1985 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.0933	n.s.	19.95
	desiccant trt. DS	4	0.0496	n.s.	
	Error	12	0.1777		
B (41 -52 mm)	R	3	5.6168	n.s.	16.38
	DS	4	5.4870	n.s.	
	Error	12	10.1380		
C (53 -75 mm)	R	3	19.5691	n.s.	14.50
	DS	4	0.8574	n.s.	
	Error	12	22.7370		
D (76 -85 mm)	R	3	16.8893	**	30.43
	DS	4	10.3033	n.s.	
	Error	12	10.5639		
J (85 mm +)	R	3	-	-	-
	DS	4	-	-	
	Error	12	-		
Total yield	R	3	40.5943	*	9.93
	DS	4	6.2133	n.s.	
	Error	12	41.8679		

Where
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 2 d. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on tuber yield of the variety Russet Burbank. 1986 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.5128	n.s.	11.61
	desiccant trt. DS	4	0.1297	n.s.	
	Error	12	0.5967		
B (41 -52 mm)	R	3	4.1019	n.s.	12.84
	DS	4	1.6112	n.s.	
	Error	12	23.6079*	n.s.	
C (53 -75 mm)	R	3	3.8737	n.s.	17.76
	DS	4	44.9341	*	
	Error	12			
D (76 -85 mm)	R	3	-	-	-
	DS	4	-	-	
	Error	12	-		
J (85 mm +)	R	3	-	-	-
	DS	4	-	-	
	Error	12	-		
Total yield	R	3	5.6587	n.s.	4.76
	DS	4	31.5359	**	
	Error	12	12.1824		

Where
** is significant at 1% level
* is significant at 5% level
n.s. is not significant at the 5% level

APPENDIX 2 e. Analyses of variance of the effect of using Hoe-39866 and diquat as dessiccants on tuber yield of the variety Sebago. 1985 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.0596	n.s.	31.76
	desiccant trt. DS	4	0.3495	n.s.	
	Error	12	0.4340		
B (41 -60 mm)	R	3	4.4146	n.s.	18.34
	DS	4	2.3764	n.s.	
	Error	12	5.1209		
C (61 -75 mm)	R	3	5.5446	n.s.	15.43
	DS	4	5.8771	n.s.	
	Error	12	8.2474		
D (76 -80 mm)	R	3	1.3648	n.s.	19.92
	DS	4	11.1438	**	
	Error	12	6.1475		
J (80 mm +)	R	3	1.4625	n.s.	63.70
	DS	4	12.4202	**	
	Error	12	5.4716		
Total yield	R	3	20.7246	n.s.	14.22
	DS	4	55.2089	**	
	Error	12	47.5683		

Where
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 2 f. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on tuber yield of the variety Sebago. 1986 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V
A (0-40 mm)	replication R	3	0.0892	n.s.	19.02
	desiccant trt. DS	4	0.1905	n.s.	
	Error	12	0.2283		
B (41-60 mm)	R	3	4.0904	n.s.	10.50
	DS	4	4.9281	n.s.	
	Error	12	5.1029		
C (61-75 mm)	R	3	7.2111	*	7.44
	DS	4	20.074	**	
	Error	12	8.1719		
D (76-80 mm)	R	3	0.9033	n.s.	35.19
	DS	4	15.7495	**	
	Error	12	6.0717		
J (80 mm +)	R	3	-	-	-
	DS	4	-	-	
	Error	12	-		
Total yield	R	3	0.9838	n.s.	4.48
	DS	4	51.4555	***	
	Error	12	9.6624		

Where
*** is significant at 0.1% level
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 3 a. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on tuber yield of the variety Kennebec. Combination of 1985-86 results.

Tuber size	Source of variation	df	SS	Pr > F	C V
A(0-40 mm)	Year YR	1	1.3876	***	31 93
	Rep in Year REP(YR)	6	0.1595	n s.	
	Desiccant Trt. DS	4	0.0600	n.s.	
	YR* DS	4	0.2479	n.s.	
	Error	24	0.5435		
B(41-60 mm)	YR	1	201.0626	***	13.57
	REP (YR)	6	3.0411	n.s.	
	DS	4	1.6355	n.s.	
	YR* DS	4	1.6552	n.s.	
	Error	24	9.3763		
C(61-75 mm)	Yr	1	772.0698	***	10.79
	REP (YR)	6	19.8345	n.s.	
	DS	4	2.3714	n.s.	
	YR* DS	4	0.2078	n.s.	
	Error	24	35.7035		
D(76-80mm)	Yr	1	363.5487	***	18 87
	REP (YR)	6	14.2616	n.s.	
	DS	4	21 3419	**	
	YR* DS	4	6.4620	n.s.	
	Error	24	24.2334		
Total Yield	Yr	1	300.4958	***	7.96
	REP (YR)	6	87.4278	**	
	DS	4	73.9566	**	
	YR* DS	4	24.2076	n.s.	
	Error	24	78.8444		

Where

*** is significant at 0.1% level
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 3 b. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on tuber yield of the variety Russet Burbank. Combination of 1985-86 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V
A(0-40 mm)	Year YR	1	17.1741	***	14.20
	Rep in YearREP(YR)	6	0.6060	*	
	Desiccant trt. DS	4	0.1415 n.s.		
	YR* DS	4	0.0377	n.s.	
	Error	24	0.7743		
B(41-52 mm)	YR	1	282.7847	***	14.34
	REP (YR)	6	9.7187	n.s.	
	DS	4	4.869	n.s.	
	YR* DS	4	2.290	n.s.	
	Error	24			
C(53-75 mm)	YR	1	15.0001	n.s.	16.03
	REP (YR)	6	23.4428	n.s.	
	DS	4	28.1051	*	
	YR* DS	4	17.6863	n.s.	
	Error	24	48.6171		
Total yield	YR	1	54.9668	*	7.51
	REP (YR)	6	46.2529	*	
	DS	4	28.7927	*	
	YR* DS	4	8.956	n.s.	
	Error	24	54.0503		

Where

*** is significant at 0.1% level
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 3 c. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on tuber yield of the variety Sebago. Combination of 1985-86 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V
A(0-40 mm)	Year YR	1	0.1594	*	25.10
	Rep in YearREP(YR)	6	0.1488	*	
	Desiccant trt. DS	4	0.2199	n.s.	
	YR* DS	4	0.3200	*	
	Error	24	0.6623		
B(41-60 mm)	YR	1	70.1058	***	13.36
	REP (YR)	6	8.5050	*	
	DS	4	3.9782	n.s	
	YR* DS	4	3.3263	n.s.	
	Error	24	10.2238		
C(61-75 mm)	YR	1	326.8695	***	10.05
	REP (YR)	6	12.7556	*	
	DS	4	19.1625	***	
	YR* DS	4	6.7889	n.s.	
	Error	24	16.4193		
D(76-80mm)	YR	1	24.7197	***	25.41
	REP (YR)	6	2.2681	n.s.	
	DS	4	18.1661	***	
	YR* DS	4	8.727	**	
	Error	24	12.219		

Where

*** is significant at 0.1% level
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 4. Single degree of freedom analyses of variance of the yield of tubers in kg per experimental plot.

Cultivar	Year	size	Source of variation	df	SS	Pr > F
Kennebec	1985	J	Rate of Hoe-39866 (kg a.i./ha) HOE	1	11.17	*
			Error	14	29.99	
"	1986	D	HOE	1	5.81	*
			Error	14	12.94	
Russet-Burbank	1986	Total	HOE	1	10.13	*
			Error	14	21.94	
Sebago	1985	J	HOE	1	7.40	**
			Error	14	11.55	
"	1986	C	HOE	1	13.73	**
			Error	14	17.60	
"	1986	Total	HOE	1	46.62	***
			Error	14	10.60	
"	1985-6	D	HOE	1	8.73	*
			Error	14	42.56	

Where

*** is significant at the 0.1% level
** is significant at 1% level
* is significant at 5 % level

APPENDIX 5. Friedman test for stem end browning following desiccation with Hoe-39866 and diquat. 1985 and 1986 results.

Cultivar	year	source	df	X_r^2	Pr > X_r^2
Kennebec	1985	Desiccant treatment DS	4	10.5000	n.s.
Kennebec	1986	DS	4	3.1538	n.s.
Russet-Burbank	1985	DS	4	7.3898	n.s.
Russet-Burbank	1986	DS	4	6.4545	n.s.
Sebago	1985	DS	4	7.8788	n.s.
Sebago	1986	DS	4	13.1700	*

Where
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 6. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on emergence of plants of tubers retained from treated plants.

Cultivar	time	Source of variation	df	SS	Pr > F	C.V.
Kennebec	28 days	replication R	3	36.55	n.s.	22.19
		desiccant trt. DS	4	198.80	*	
		Error	12	139.20		
Kennebec	42 days	R	3	6.80	*	3.67
		DS	4	42.70	***	
		Error	12	5.70		
Russet-Burbank	28 days	R	3	70.95	*	16.02
		DS	4	219.70	**	
		Error	12	78.3		
Russet-Burbank	42 days	R	3	3.60	n.s.	3.46
		DS	4	13.80	**	
		Error	12	5.39		
Sebago	28 days	R	3	18.95	n.s.	49.49
		DS	4	28.70	n.s.	
		Error	12	87.29		
Sebago	42 days	R	3	14.60	n.s.	7.63
		DS	4	46.50	**	
		Error	12	23.80		

Where
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 7. Single degree of freedom analyses of variance of the number of plants emerged per experimental plot.

Cultivar	time	Source of variation	df	SS	Pr > F
Kennebecs	28 days	Rate of Hoe-39866 (kg a.i./ha) HOE	1	171.61	**
		Error	14	192.14	
Kennebec	42 days	HOE	1	32.54	***
		Error	14	17.40	
Russet-Burbank	28 days	HOE	1	144.03	**
		Error	14	151.97	
Russet-Burbank	42 days	HOE	1	9.26	**
		Error	14	11.74	
Sebago	42 days	HOE	1	151.22	*
		Error	14	244.22	

Where

*** is significant at the 0.1% level
** is significant at 1% level
* is significant at 5 % level

APPENDIX 8. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on yield of tubers retained from treated plants.

Cultivar	size	Source of variation	df	SS	Pr > F	C.V.
Kennebec	A	replication R	3	0.1805	n.s	42.62
		desiccant trt. DS	4	0.2222	n.s.	
		Error	12	0.7320		
"	B	R	3	3.6938	n.s.	26.14
		DS	4	28.8730	n.s.	
		Error	12	27.0540		
"	C	R	3	4.7516	n.s.	16.67
		DS	4	43.8303	n.s.	
		Error	12	42.2908		
"	D	R	3	0.2309	n.s.	50.84
		DS	4	4.6031	n.s.	
		Error	12	5.7215		
"	Total	R	3	9.6971	n.s.	13.06
		DS	4	121.6320	*	
		Error	12	73.4951		
Russet-Burbank	A	R	3	1.5820	n.s.	31.70
		DS	4	1.754	n.s.	
		Error	12	14.1209		
"	B	R	3	14.3408	n.s.	11.75
		DS	4	43.0801	**	
		Error	12	23.1487		
"	C	R	3	9.3497	***	29.79
		DS	4	4.1585	*	
		Error	12	2.9150		
"	T	R	3	14.6877	n.s.	9.55
		DS	4	79.7030	**	
		Error	12	31.2127		

(table continued)

APPENDIX 8 . (continued)

Cultivar	size	Source of variation	df	SS	Pr > F	C.V.
Sebago	A	R	3	0.2642	n.s.	30.03
		DS	4	0.1578	n.s.	
		Error	12	0.5372		
"	B	R	3	4.1880	n.s.	28.94
		DS	4	6.1130	n.s.	
		Error	12	27.2374		
"	C	R	3	11.6765	n.s.	21.45
		DS	4	12.9649	n.s.	
		Error	12	22.1272		
"	D	R	3	0.4759	n.s.	124.73
		DS	4	0.5378	n.s.	
		Error	12	2.6815		
"	T	R	3	26.4499	n.s.	18.06
		DS	4	27.5902	n.s.	
		Error	12	61.9316		

Where
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 9. Single degree of freedom analyses of variance of the yield of tubers in kg per experimental plot. Replant studies.

Cultivar	size	Source of variation	df	SS	Pr > F
Kennebec	Total	Rate of Hoe-39866 (kg a.i./ha) HOE	1	111.64	***
		Error	14	82.71	
Russet-Burbank	B	HOE	1	29.75	**
		Error	14	33.66	
	Total	HOE	1	55.14	***
		Error	14	42.14	

Where

*** is significant at the 0.1% level
** is significant at 1% level

APPENDIX 10 a. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. Kennebec 1986 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	598.80	n.s.	24.51
	Desiccant trt. DS	4	780.60	n.s.	
	R * DS	12	2469.53	**	
	Error	40	2866.00		
21 days	replication R	3	505.20	n.s.	21.59
	Desiccant trt. DS	4	2326.17	n.s.	
	R * DS	12	4192.63	***	
	Error	40	10314.00		
28 days	replication R	3	3044.32	n.s.	44.97
	Desiccant trt. DS	4	10664.83	n.s.	
	R * DS	12	13729.43	*	
	Error	40	22792.00		
Fresh weight (28 days)	replication R	3	1.7226	n.s.	34.46
	Desiccant trt. DS	4	26.36	*	
	Error	12	18.84		
Dry weight (28 days)	replication R	3	0.0412	n.s.	25.83
	Desiccant trt. DS	4	0.3908	*	
	Error	12	0.2020		

Where

** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 10 b. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. Kennebec 1987 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	369.40	n.s.	32.78
	Desiccant trt. DS	4	2767.43	***	
	R * DS	12	1461.10	n.s.	
	Error	40	3540.67		
21 days	replication R	3	179.12	n.s.	37.14
	Desiccant trt. DS	4	6972.27	**	
	R * DS	12	2470.80	n.s.	
	Error	40	7264.00		
28 days	replication R	3	24.67	n.s.	48.54
	Desiccant trt. DS	4	17920.10	**	
	R * DS	12	8722.17	n.s.	
	Error	40	20934.00		
Fresh weight (28 days)	replication R	3	3.1548	n.s.	59.98
	Desiccant trt. DS	4	37.4943	**	
	R * DS	12	15.0644	n.s.	
	Error	40	45.2776		
Dry weight (28 days)	replication R	3	0.0563	n.s.	48.64
	Desiccant trt. DS	4	0.4971	**	
	R * DS	12	0.2150	n.s.	
	Error	40	0.5175		

Where
*** is significant at the 0.1% level
** is significant at 1% level
n.s. is not significant at the 5% level

APPENDIX 10 c. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. Russet Burbank, 1986 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	4664.18	**	42.38
	Desiccant trt. DS	4	12190.93	***	
	R * DS	12	2725.73	n.s.	
	Error	40	24353.33		
21 days	replication R	3	13026.47	n.s.	54.70
	Desiccant trt. DS	4	93931.17	***	
	R * DS	12	25064.70	n.s.	
	Error	40	109142.67		
Fresh weight (21 days)	replication R	3	6.3289	n.s.	29.25
	Desiccant trt. DS	4	54.1886	***	
	Error	12	11.6922		
Dry weight (21 days)	replication R	3	0.0578	n.s.	25.93
	Desiccant trt. DS	4	0.5789	***	
	Error	12	0.1168		

Where
*** is significant at 0.1% level
** is significant at 1 % level
n.s. is not significant at the 5% level

APPENDIX 10 d. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. Russet Burbank 1987 results.

Time	Source of variation	df	SS	Pr > F	C.V
14 days	replication R	3	1241.78	n.s.	38.17
	Desiccant trt. DS	4	17535.07	***	
	R * DS	12	1754.80	n.s.	
	Error	40	9162.00		
21 days	replication R	3	1764.58	n.s.	41.09
	Desiccant trt. DS	4	31410.90	***	
	R * DS	12	3557.50	n.s.	
	Error	40	16116.67		
28 days	replication R	3	1558.58	n.s.	46.05
	Desiccant trt. DS	4	56714.57	***	
	R * DS	12	8155.17	n.s.	
	Error	40	29050.67		
Fresh weight (28 days)	replication R	3	7.4382	n.s.	66.91
	Desiccant trt. DS	4	61.2979	***	
	R * DS	12	9.7025	n.s.	
	Error	40	40.2449		
Dry weight (28 days)	replication R	3	0.1289	*	78.16
	Desiccant trt. DS	4	0.8073	***	
	R * DS	12	0.1423	n.s.	
	Error	40	0.5707		

Where
*** is significant at 0.1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 10 e. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. Sebago 1986 results.

Time	Source of variation	df	SS	Pr > F	C.V
14 days	replication R	3	17.9167	n.s.	35.06
	Desiccant trt. DS	4	2571.07	**	
	R * DS	12	1158.00	n.s.	
	Error	40	3942.00		
21 days	replication R	3	103.78	n.s.	39 72
	Desiccant trt. DS	4	4225.50	***	
	R * DS	12	1039.30	n.s.	
	Error	40	7768.00		
28 days	replication R	3	201.5167	n.s.	45 12
	Desiccant trt. DS	4	7654.43	**	
	R * DS	12	3179.57	n.s.	
	Error	40	12999.33		
Fresh weight (28 days)	replication R	3	0.8881	n.s.	35 79
	Desiccant trt. DS	4	16.6377	*	
	Error	12	10.1963		
Dry weight (28 days)	replication R	3	0.0162	n.s.	33 40
	Desiccant trt. DS	4	0.3327	*	
	Error	12	0.1966		

Where
- *** is significant at 0.1% level
- ** is significant at 1% level
- * is significant at 5 % level
- n.s. is not significant at the 5% level

APPENDIX 10 f. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. Sebago 1987 results.

Time	Source of variation	df	SS	Pr>F	C.V.
14 days	replication R	3	236.40	n.s.	31.94
	Desiccant trt. DS	4	2849.67	*	
	R * DS	12	2432.60	***	
	Error	40	2688.67		
21 days	replication R	3	138.67	n.s.	32.21
	Desiccant trt. DS	4	3561.77	*	
	R * DS	12	2611.83	*	
	Error	40	3458.33		
28 days	replication R	3	67.25	n.s.	31.53
	Desiccant trt. DS	4	4074.73	*	
	R * DS	12	2878.33	*	
	Error	40	3866.67		
Fresh weight (28 days)	replication R	3	0.4883	n.s.	58.38
	Desiccant trt. DS	4	2.9033	n.s.	
	R * DS	12	6.5275	n.s.	
	Error	40	11.1856		
Dry weight (28 days)	replication R	3	0.0108	n.s.	57.25
	Desiccant trt. DS	4	0.0464	n.s.	
	R * DS	12	0.1279	n.s.	
	Error	40	0.2331		

Where

*** is significant at 0.1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 11 a. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. Kennebecs 1985-86 combined results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	year YR	1	380.28	*	23.16
	Rep in year REP(YR)	6	302.29	n.s.	
	desiccant trt. DS	4	897.09	**	
	YR * DS	4	243.80	n.s.	
	Error	24	1272.88		
21 days	YR	1	326.80	*	24.58
	REP(YR)	6	228.11	n.s.	
	DS	4	2571.32	***	
	YR * DS	4	528.16	n.s.	
	Error	24	2221.14		
28 days	YR	1	354.03	n.s.	35.24
	REP(YR)	6	1022.99	n.s.	
	DS	4	8609.35	***	
	YR * DS	4	918.96	n.s.	
	Error	24	7483.87		
Fresh weight (28 days)	YR	1	33.8081	***	36 59
	REP(YR)	6	2.5067	n.s.	
	DS	4	31.9563	***	
	YR * DS	4	6.9519	n.s.	
	Error	24	23.7161		
Dry weight (28 days)	YR	1	0.7212	***	29 04
	REP(YR)	6	0.0600	n.s.	
	DS	4	0.4410	***	
	YR * DS	4	0.1153	n.s.	
	Error	24	0.2742		

Where
*** is significant at 0.1% level
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 11 b. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. R.Burbank 1985-86 combined results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	year YR	1	3264.04	***	18.61
	Rep in year REP(YR)	6	2099.99	**	
	desiccant trt. DS	4	8826.27	***	
	YR * DS	4	720.14	n.s.	
	Error	24	1970.44		

Where
- *** is significant at 0.1% level
- ** is significant at 1% level
- * is significant at 5 % level
- n.s. is not significant at the 5% level

APPENDIX 11 c. Analyses of variance of the effect of using Hoe-39866 and diquat as desiccants on sprout length and weight of retained tubers. Sebago 1985-86 combined results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	year YR	1	70.23	n.s.	26.16
	Rep in year REP(YR)	6	84.77	n.s.	
	desiccant trt. DS	4	1724.37	***	
	YR * DS	4	82.54	n.s.	
	Error	24	1196.87		
21 days	YR	1	386.47	**	22.27
	REP(YR)	6	80.82	n.s.	
	DS	4	2505.07	***	
	YR * DS	4	90.68	n.s.	
	Error	24	1217.04		
28 days	YR	1	768.54	***	25.79
	REP(YR)	6	89.59	n.s.	
	DS	4	3703.10	***	
	YR * DS	4	206.62	n.s.	
	Error	24	2019.3		
Fresh weight (28 days)	YR	1	27.8740	***	41.25
	REP(YR)	6	1.0510	n.s.	
	DS	4	11.9635	**	
	YR * DS	4	5.6418	n.s.	
	Error	24	12.3722		
Dry weight (28 days)	YR	1	0.6245	***	38.65
	REP(YR)	6	0.0197	n.s.	
	DS	4	0.2214	**	
	YR * DS	4	0.1268	*	
	Error	24	0.2392		

Where
- *** is significant at 0.1% level
- ** is significant at 1% level
- * is significant at 5 % level
- n.s. is not significant at the 5% level

APPENDIX 12. Single degree of freedom analyses of variance of the sprout length and weight of retained tubers with rate of Hoe-39866 (kg a.i./ha).

Cultivar	Year	dependent variable	Source of variation	df	SS	Pr > F
Kennebec	1985-6	sprout length day 14	Rate of Hoe-39866 (kg a.i./ha) HOE	1	420.18	*
				Error	30	1943.48
"	1985-6	sprout length day 21	HOE	1	1498.89	***
			Error	30	2618.61	
"	1985-6	sprout length day 28	HOE	1	4017.91	***
			Error	30	6243.82	
"	1985-6	Fresh weigth day 28	HOE	1	23.11	***
			Error	30	52.21	
"	1985-6	Dry weigth day 28	HOE	1	0.3377	**
			Error	30	0.9397	
Russet-Burbank	1985-6	sprout length day 14	HOE	1	4375.29	***
			Error	30	6081.68	
"	1986	Fresh weigth day 28	HOE	1	11.4171	***
			Error	30	7.0209	
"	1986	Dry weigth day 28	HOE	1	0.1558	***
			Error	30	0.1123	

(table continued)

APPENDIX 12. (continued)

Cultivar	Year	dependent variable	Source of variation	df	SS	Pr > F
Sebago	1985-6	sprout length day 14	HOE	1	953.40	***
			Error	30	1417.90	
"	1985-6	sprout length day 21	HOE	1	1432.54	***
			Error	30	1910.30	
"	1985-6	sprout length day 28	HOE	1	2285.70	***
			Error	30	2818.70	
"	1985-6	Fresh weigth day 28	HOE	1	10.38	**
			Error	30	37 49	
"	1985-6	Dry weigth day 28	HOE	1	0.2059	*
			Error	30	0.8261	

Where

*** is significant at the 0.1% level
** is significant at 1% level
* is significant at 5 % level

APPENDIX 13. Friedman test for leaf desiccation with Hoe-39866 in combination with diquat. 1985 and 1986 results.

Cultivar	year	time	source	df	X_r^2	$Pr > X_r^2$
Kennebec	1985	7 days	desiccant treatment DS	7	26.67	**
"	"	14 days	DS	7	30.93	**
"	"	21 days	DS	7	31.09	**
"	1986	7 days	DS	7	29.93	**
"	"	14 days	DS	7	52.75	**
"	"	21 days	DS	7	28.01	**
Russet-Burbank	1985	7 days	DS	7	21.24	**
"	"	14 days	DS	7	29.53	**
"	"	21 days	DS	7	31.33	**
"	1986	7 days	DS	7	28.63	**
"	"	14 days	DS	7	49.06	**
"	"	21 days	DS	7	26.73	**
Sebago	1985	7 days	DS	7	30.01	**
"	"	14 days	DS	7	26.79	**
"	"	21 days	DS	7	35.71	**
"	1986	7 days	DS	7	31.51	**
"	"	14 days	DS	7	24.44	**
"	"	21 days	DS	7	27.25	**

Where

** is significant at 1% level

APPENDIX 14. Friedman test for stem desiccation with Hoe-39866 in combination with diquat. 1985 and 1986 results.

Cultivar	year	time	source	df	X_r^2	$Pr > X_r^2$
Kennebec	1985	7 days	desiccant treatment DS	7	84.93	**
"	"	14 days	DS	7	29.11	**
"	"	21 days	DS	7	32.98	**
"	1986	7 days	DS	7	30.11	**
"	"	14 days	DS	7	38.01	**
"	"	21 days	DS	7	55.58	**
Russet-Burbank	1985	7 days	DS	7	39.42	**
"	"	14 days	DS	7	23.90	**
"	"	21 days	DS	7	26.35	**
"	1986	7 days	DS	7	240.89	**
"	"	14 days	DS	7	28.64	**
"	"	21 days	DS	7	33.83	**
Sebago	1985	7 days	DS	7	40.11	**
"	"	14 days	DS	7	36.20	**
"	"	21 days	DS	7	23.49	**
"	1986	7 days	DS	7	0	n.s.
"	"	14 days	DS	7	31.63	**
"	"	21 days	DS	7	28.12	**

Where

** is significant at 1% level

n.s. is not significant at the 5% level

APPENDIX 15 a. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccation treatments on tuber yield of the variety Kennebec. 1985 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.0028	n.s.	53.82
	desiccant trt. DS	7	0.0984	n.s.	
	Error	21	0.6059		
B (41 -60 mm)	R	3	0.2878	n.s.	25.51
	DS	7	0.7559	n.s.	
	Error	21	6.2234		
C (61 -75 mm)	R	3	0.8183	n.s.	23.46
	DS	7	8.2737	n.s.	
	Error	21	53.5785		
D (76 -80 mm)	R	3	1.7127	n.s.	22.71
	DS	7	30.9249	n.s.	
	Error	21	82.5066		
J (80 mm +)	R	3	1.3300	n.s.	53.89
	DS	7	7.2700		
	Error	21	46.7488		
Total yield	R	3	6.5553	n.s.	10.56
	DS	7	32.9109	n.s.	
	Error	21	100.8109		

Where

n.s. is not significant at the 5% level

APPENDIX 15 b Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccation treatments on tuber yield of the variety Kennebec. 1986 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.1353	n.s.	29.04
	desiccant trt. DS	7	0.1715	n.s.	
	Error	21	0.8305		
B (41 -60 mm)	R	3	4.6968	n.s.	15.15
	DS	7	17.8248	n.s.	
	Error	21	23.7136		
C (61 -75 mm)	R	3	9.7287	n.s.	13.88
	DS	7	30.6285	n.s.	
	Error	21	91.5395		
D (76 -80 mm)	R	3	1.3435	n.s.	53.20
	DS	7	4.4303	n.s.	
	Error	21	25.6628		
Total yield	R	3	3.2880	n.s.	7.79
	DS	7	29.8522	n.s.	
	Error	21	77.5228		

Where

n.s. is not significant at the 5% level

APPENDIX 15 c. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccation treatments on tuber yield of the variety Russet Burbank. 1985 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.4406	n.s.	45.91
	desiccant trt. DS	7	0.7025	n.s.	
	Error	21	2.6156		
B (41 -52 mm)	R	3	1.1375	n.s.	20.11
	DS	7	19.0025	n.s.	
	Error	21	23.8500		
C (53 -75 mm)	R	3	3.0415	n.s.	16.69
	DS	7	14.1105	n.s.	
	Error	21	66.6629		
D (76 -85 mm)	R	3	4.0478	n.s.	46.46
	DS	7	20.4672	n.s.	
	Error	21	42.7797		
J (85 mm +)	R	3	0.3919	n.s.	286.98
	DS	7	2.5725	*	
	Error	21	2.9794		
Total yield	R	3	0.5002	n.s.	10.28
	DS	7	12.9455	n.s.	
	Error	21	88.3016		

Where

* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 15 d. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccation treatments on tuber yield of the variety Russet Burbank. 1986 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.3098	n.s.	28.71
	desiccant trt. DS	7	2.8356	n.s.	
	Error	21	5.9122		
B (41 -52 mm)	R	3	12.1925	n.s.	14.62
	DS	7	22.6631	n.s.	
	Error	21	48.0568		
C (53 -75 mm)	R	3	12.9035	n.s.	17.12
	DS	7	34.1806	*	
	Error	21	37.5164		
Total yield	R	3	29.2866	n.s.	9.60
	DS	7	62.7890	n.s.	
	Error	21	77.4808		

Where

* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 15 e. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccation treatments on tuber yield of the variety Sebago. 1985 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.0869	n.s.	29.84
	desiccant trt. DS	7	0.110	n.s.	
	Error	21	0.6731		
B (41 -60 mm)	R	3	0.7396	n.s.	20.23
	DS	7	3.6396	n.s.	
	Error	21	10.5861		
C (61 -75 mm)	R	3	5.6032	n.s.	21.39
	DS	7	17.1644	n.s.	
	Error	21	33.9443		
D (76 -80 mm)	R	3	2.0232	n.s.	35.25
	DS	7	9.3143	n.s.	
	Error	21	31.5231		
J (80 mm +)	R	3	1.2816	n.s.	107.48
	DS	7	8.5284	n.s.	
	Error	21	15.8922		
Total yield	R	3	73.4167	n.s.	45.88
	DS	7	284.4358	n.s.	
	Error	21	1065.1395		

Where

n.s. is not significant at the 5% level

APPENDIX 15 f. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccation treatments on tuber yield of the variety Sebago. 1986 results.

Tuber size	Source of variation	df	SS	Pr > F	C.V.
A (0 -40 mm)	replication R	3	0.2224	n.s.	25.69
	desiccant trt. DS	7	0.3289	n.s.	
	Error	21	0.8830		
B (41 -60 mm)	R	3	0.7396	n.s.	15.20
	DS	7	11.6684	n.s.	
	Error	21	20.5714		
C (61 -75 mm)	R	3	17.1980	n.s.	19.93
	DS	7	14.6069	n.s.	
	Error	21	85.1088		
D (76 -80 mm)	R	3	1.4223	n.s.	58.61
	DS	7	22.8397	**	
	Error	21	16.3426		
Total yield	R	3	72.4411	n.s.	15.46
	DS	7	61.8195	n.s.	
	Error	21	186.6132		

Where

** is significant at the 5% level
n.s. is not significant at the 5% level

APPENDIX 16. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccation treatments on tuber yield of potatoes 1985-1986 combined results.

Cultivar	size	Source of variation	df	SS	Pr > F	C.V.
Kennebec	A	year(YR)	1	2.1793	***	36.98
		rep in year REP(YR)	6	0.1381	n.s.	
		desiccant treat. DS	7	0.1430	n.s.	
		YR * DS	7	0.1270	n.s.	
		Error	42	1.4364		
"	C	YR	1	1084.7966	***	17.01
		REP(YR)	6	10.5471	n.s.	
		DS	7	12.9442	n.s.	
		YR * DS	7	25.9579	n.s.	
		Error	42	145.1180		
"	Total	YR	1	245.3139	***	9.08
		REP(YR)	6	9.8433	n.s.	
		DS	7	39.9493	n.s.	
		YR * DS	7	22.8138	n.s.	
		Error	42	178.3337		
Russet-Burbank	C	YR	1	131.7330	***	17.04
		REP(YR)	6	15.9450	n.s.	
		DS	7	13.3182	n.s.	
		YR * DS	7	34.9729	n.s.	
		Error	42	104.1793		
"	Total	YR	1	0.0523	n.s.	9.95
		REP(YR)	6	29.7868	n.s.	
		DS	7	26.1708	n.s.	
		YR * DS	7	49.5637	n.s.	
		Error	42	165.7824		
Sebago	A	YR	1	0.6281	*	27.54
		REP(YR)	6	0.3092	n.s.	
		DS	7	0.2012	n.s.	
		YR * DS	7	0.2377	n.s.	
		Error	42	1.5561		

(table continued)

APPENDIX 16. (continued)

Cultivar	size	Source of variation	df	SS	Pr > F	C.V.
Sebago	B	YR	1	110.3958	***	17.05
		REP(YR)	6	1.4792	n.s.	
		DS	7	9.6661	n.s.	
		YR * DS	7	5.6419	n.s.	
		Error	42	31.1575		
"	Total	YR	1	226.0512	*	31.38
		REP(YR)	6	145.8578	n.s.	
		DS	7	264.9140		
		YR * DS	7	81.3413		
		Error	42	1251.7527		

Where

*** is significant at the 0.1% level
* is significant at the 5 % level
n.s. is not significant at the 5% level

APPENDIX 17. Friedman test for stem end browning following desiccation with Hoe-39866 alone and in combination with diquat. 1985 and 1986 results.

Cultivar	year	source	df	X_r^2	$Pr > X_r^2$
Kennebec	1985	Desiccant treatment DS	7	18.08	*
Kennebec	1986	DS	7	51.54	**
Russet-Burbank	1985	DS	7	23.25	**
Russet-Burbank	1986	DS	7	39.38	**
Sebago	1985	DS	7	12.47	n.s.
Sebago	1986	DS	7	26.27	**

Where
* is significant at 5 % level
** is significant at the 1% level
n.s. is not significant at the 5% level

APPENDIX 18. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on emergence of plants of tubers retained from treated plants.

Cultivar	time	Source of variation	df	SS	Pr > F	C.V.
Kennebec	28 days	replication R	3	28.4688	n.s.	11.87
		desiccant trt. DS	7	39.4688	n.s.	
		Error	21	81.4063		
Kennebec	42 days	R	3	1.6250	n.s.	4.78
		DS	7	7.3750	n.s.	
		Error	21	17.8750		
Russet-Burbank	28 days	R	3	3.3438	n.s.	8.23
		DS	7	9.9688	n.s.	
		Error	21	46.9063		
Russet-Burbank	42 days	R	3	3.00	n.s	2.92
		DS	7	4.00	n.s.	
		Error	21	7.00		
Sebago	28 days	R	3	42.75	n.s.	39.96
		DS	7	120.50	n.s.	
		Error	21	256.75		
Sebago	42 days	R	3	2.25	n.s.	6.68
		DS	7	5.00	n.s.	
		Error	21	34.75		

Where

n.s. is not significant at the 5% level

APPENDIX 19. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on yield of tubers retained from treated plants.

Cultivar	size	Source of variation	df	SS	Pr > F	C V
Kennebec	A	replication R	3	0.1790	n.s.	38.34
		desiccant trt. DS	7	0.8535	n.s.	
		Error	21	1.0998		
"	B	R	3	1.5549	n.s.	17 36
		DS	7	10.2321	n.s.	
		Error	21	18.8570		
"	C	R	3	12.5052	n.s.	15.22
		DS	7	17.1503	n.s.	
		Error	21	61.4830		
"	D	R	3	3.9679	n.s.	54.67
		DS	7	13.0240	n.s.	
		Error	21	16.2643		
"	Total	R	3	9.5034	n.s.	8.43
		DS	7	18.9989	n.s	
		Error	21	53.6955		
Russet-Burbank	A	R	3	0.9501	n.s.	19.40
		DS	7	3.2876	n.s.	
		Error	21	9.3572		
"	B	R	3	4.4215	n.s.	16.51
		DS	7	41.9980	n.s.	
		Error	21	74.6996		
"	C	R	3	1.6582	n.s.	40.29
		DS	7	2.9900	n.s.	
		Error	21	14.8776		
"	T	R	3	8.3517	n.s.	13.31
		DS	7	55.0188	n.s.	
		Error	21	106.7717		

(table continued)

APPENDIX 19. (continued)

Cultivar	size	Source of variation	df	SS	Pr > F	C.V.
Sebago	A	R	3	0.0346	n.s.	29.82
		DS	7	6.8236	*	
		Error	21	0.8242		
"	B	R	3	2.1977	n.s.	20.68
		DS	7	5.3902	n.s.	
		Error	21	23.7881		
"	C	R	3	5.9261	n.s.	19.03
		DS	7	7.6408	n.s.	
		Error	21	33.9472		
"	D	R	3	1.4036	n.s.	105.78
		DS	7	1.9071	n.s.	
		Error	21	3.3428		
"	T	R	3	1.7604	n.s.	14.86
		DS	7	12.8815	n.s.	
		Error	21	65.6073		

Where

* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 20 a. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on sprout length and weight of retained tubers. Kennebec 1986 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	512.11	*	20.86
	Desiccant trt. DS	7	1081.91	*	
	R * DS	21	1022.47	n.s.	
	Error	64	3730.67		
21 days	replication R	3	1684.21	n.s.	33.28
	Desiccant trt. DS	7	5625.96	n.s.	
	R * DS	21	6827.99	n.s.	
	Error	64	15668.00		
28 days	replication R	3	1577.83	n.s.	45.95
	Desiccant trt. DS	7	12177.83	n.s.	
	R * DS	21	15141.75	n.s.	
	Error	64	50206.67		
Fresh weight (28 days)	replication R	3	0.8295	n.s.	24.17
	Desiccant trt. DS	7	28.0069	*	
	Error	21	332.7887		
Dry weight (28 days)	replication R	3	0.0042	n.s.	21.16
	Desiccant trt. DS	7	0.3029	n.s.	
	Error	21	0.4282		

Where

* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 20 b. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on sprout length and weight of retained tubers. Kennebec 1987 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	113.61	n.s.	31.43
	Desiccant trt. DS	7	4817.49	**	
	R * DS	21	2725.14	n.s.	
	Error	64	7756.67		
21 days	replication R	3	300.86	n.s.	42.81
	Desiccant trt. DS	7	16669.07	***	
	R * DS	21	7620.55	n.s.	
	Error	64	29794.67		
28 days	replication R	3	1266.61	n.s.	49.26
	Desiccant trt. DS	7	48583.99	***	
	R * DS	21	20700.97	n.s.	
	Error	64	71749.33		
Fresh weight (28 days)	replication R	3	0.8561	n.s.	25.77
	Desiccant trt. DS	7	18.2639	***	
	Error	21	5.8117		
Dry weight (28 days)	replication R	3	0.0074	n.s.	20.64
	Desiccant trt. DS	7	0.2080	***	
	Error	21	0.0555		

Where
*** is significant at 0.1% level
** is significant at 1 % level
n.s. is not significant at the 5% level

APPENDIX 20 c. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on sprout length and weight of retained tubers. Russet Burbank 1986 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	536.58	n.s.	35.72
	Desiccant trt. DS	7	5927.00	n.s.	
	R * DS	21	13588.25	n.s.	
	Error	64	27828.67		
21 days	replication R	3	41505.21	*	55.43
	Desiccant trt. DS	7	45520.29	n.s.	
	R * DS	21	87618.79	n.s.	
	Error	64	273495.33		
Fresh weight (21 days)	replication R	3	10.4949	n.s.	32.35
	Desiccant trt. DS	7	26.06	n.s.	
	Error	21	48.38		
Dry weight (21 days)	replication R	3	0.1332	n.s.	33.09
	Desiccant trt. DS	7	0.2579	n.s.	
	Error	21	0.6621		

Where

* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 20 d. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on sprout length and weight of retained tubers. Russet Burbank 1987 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	83.53	n.s.	40.21
	Desiccant trt. DS	7	8944.99	*	
	R * DS	21	9137.05	*	
	Error	64	14969.33		
21 days	replication R	3	616.71	n.s.	45.16
	Desiccant trt. DS	7	23706.63	*	
	R * DS	21	20687.63	*	
	Error	64	33594.00		
28 days	replication R	3	584.08	n.s.	46.59
	Desiccant trt. DS	7	48167.17	**	
	R * DS	21	33381.92	*	
	Error	64	56675.33		
Fresh weight (28 days)	replication R	3	0.4769	n.s.	52.99
	Desiccant trt. DS	7	10.7737	n.s.	
	Error	21	14.4838		
Dry weight (28 days)	replication R	3	0.0101	n.s.	54.67
	Desiccant trt. DS	7	0.0967	n.s.	
	Error	21	0.2059		

Where
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 20 e. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on sprout length and weight of retained tubers. Sebago 1986 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	174.04	n.s.	22.10
	Desiccant trt. DS	7	413.29	n.s.	
	R * DS	21	940.63	n.s.	
	Error	64	2482.67		
21 days	replication R	3	652.28	n.s.	26.32
	Desiccant trt. DS	7	506.91	n.s.	
	R * DS	21	2350.72	n.s.	
	Error	64	6037.33		
28 days	replication R	3	899.86	n.s.	28.93
	Desiccant trt. DS	7	283.74	n.s.	
	R * DS	21	2350.72	n.s.	
	Error	64	7730.67		
Fresh weight (28 days)	replication R	3	4.0800	n.s.	29.25
	Desiccant trt. DS	7	6.2330	n.s.	
	Error	21	22.4777		
Dry weight (28 days)	replication R	3	0.0652	n.s.	29.66
	Desiccant trt. DS	7	0.1683	n.s.	
	Error	21	0.5191		

Where

n.s. is not significant at the 5% level

APPENDIX 20 f. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on sprout length and weight of retained tubers. Sebago 1987 results.

Time	Source of variation	df	SS	Pr > F	C.V.
14 days	replication R	3	564.28	n.s.	33.04
	Desiccant trt. DS	7	4386.74	**	
	R * DS	21	3491.30	*	
	Error	64	5480.67		
21 days	replication R	3	661.42	n.s.	35.16
	Desiccant trt. DS	7	7540.33	*	
	R * DS	21	6500.25	*	
	Error	64	10157.33		
28 days	replication R	3	1938.20	n.s.	42.81
	Desiccant trt. DS	7	15293.49	*	
	R * DS	21	14928.72	*	
	Error	64	22137.33		
Fresh weight (28 days)	replication R	3	0.4574	n.s.	59.87
	Desiccant trt. DS	7	4.7593	*	
	Error	21	5.1356		
Dry weight (28 days)	replication R	3	0.0062	n.s.	57.12
	Desiccant trt. DS	7	0.0614	n.s.	
	Error	21	0.0767		

Where
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 21. Analyses of variance of the effect of using Hoe-39866 alone and in combination with diquat as desiccants on sprout length and weight of retained tubers. 1985-86 combined results.

Cultivar	dependent variable	Source of variation	df	SS	Pr > F	C.V.
Kennebec	sprout length (21 days)	year YR	1	183.38	n.s.	21.98
		rep in year REP(YR)	6	661.69	n.s.	
		desiccant trt. DS	7	1780.12	*	
		YR * DS	7	5651.55	**	
		Error	42	4816.11		
Kennebec	sprout length (28 days)	year YR	1	786.34	n.s.	26.16
		rep in year REP(YR)	6	931.34	n.s.	
		desiccant trt. DS	7	7638.12	**	
		YR * DS	7	12615.82	***	
		Error	42	11947.57		
Russet-Burbank	sprout length (14 days)	year YR	1	933.34	**	30.23
		rep in year REP(YR)	6	384.43	n.s.	
		desiccant trt. DS	7	5093.10	*	
		YR * DS	7	4784.77	*	
		Error	42	11425.29		

Where

*** is significant at 0.1% level
** is significant at 1% level
* is significant at 5 % level
n.s. is not significant at the 5% level

APPENDIX 22 a. Analyses of variance of the effect of dipping Sebago tubers in solutions of different concentration of Hoe-39866. Results of the first experiment.

Time	Source of variation	df	SS	Pr>F	C.V.
7 days	replication R	3	119.04	n.s.	23.51
	Desiccant trt. DS	7	1575.63	***	
	R * DS	21	416.96	n.s.	
	Error	64	1202.00		
14 days	replication R	3	112.38	n.s.	27.03
	Desiccant trt. DS	7	10170.96	***	
	R * DS	21	1651.29	n.s.	
	Error	64	6523.33		
21 days	replication R	3	310.03	n.s.	35.70
	Desiccant trt. DS	7	11248.24	***	
	R * DS	21	2407.39	n.s.	
	Error	64	13055.33		
28 days	replication R	3	348.08	n.s.	34.14
	Desiccant trt. DS	7	11210.00	***	
	R * DS	21	2407.39	n.s.	
	Error	64	12541.33		
Fresh weight (28 days)	replication R	3	1.4800	n.s.	20.126
	Desiccant trt. DS	7	16.3236	***	
	Error	21	4.5497		
Dry weight (28 days)	replication R	3	0.0456	n.s.	19.67
	Desiccant trt. DS	7	0.3497	***	
	Error	21	0.1091		

Where

*** is significant at 0.1% level

n.s. is not significant at the 5% level

APPENDIX 22 b. Analyses of variance of the effect of dipping Sebago tubers in solutions of different concentration of Hoe-39866. Results of the second experiment.

Time	Source of variation	df	SS	Pr > F	C.V.
7 days	replication R	3	158.33	n.s.	43.91
	Desiccant trt. DS	7	693.33	*	
	R * DS	21	736.67	n.s.	
	Error	64	1826.00		
14 days	replication R	3	268.53	n.s.	31.20
	Desiccant trt. DS	7	3587.74	***	
	R * DS	21	1371.22	n.s	
	Error	64	4028.00		
21 days	replication R	3	77.25	n.s.	29.22
	Desiccant trt. DS	7	4229.67	***	
	R * DS	21	1995.58	n.s.	
	Error	64	5040.00		
28 days	replication R	3	169.36	n.s.	28.95
	Desiccant trt. DS	7	3517.66	**	
	R * DS	21	2819.22	n.s.	
	Error	64	5054.00		
Fresh weight (28 days)	replication R	3	1.0274	n.s.	28.15
	Desiccant trt. DS	7	25.4802	***	
	Error	21	13.0158		
Dry weight (28 days)	replication R	3	0.0660	n.s.	30.01
	Desiccant trt. DS	7	1.1217	**	
	Error	21	0.6310		

Where

*** is significant at 0.1% level
** is significant at 1 % level
n.s. is not significant at the 5% level

APPENDIX 23. Analyses of variance of the effect of dipping Sebago tubers in solutions of different concentration of Hoe-39866. Combined results of the two experiments

Time	Source of variation	df	SS	Pr > F	C.V.
7 days	run RU	1	629.17	***	19.77
	rep in run REP(RU)	6	101.46	n.s.	
	Desiccant trt. DS	7	633.72	***	
	RU * DS	7	122.60	n.s.	
	Error	42	384.54		
14 days	run RU	1	2276.09	***	15.60
	rep in run REP(RU)	6	126.97	n.s.	
	Desiccant trt. DS	7	4050.83	***	
	RU * DS	7	535.40	**	
	Error	42	1007.50		
21 days	run RU	1	1485.46	***	16.80
	rep in run REP(RU)	6	129.09	n.s.	
	Desiccant trt. DS	7	4556.94	***	
	RU * DS	7	602.36		
	Error	42	1467.66		
28 days	run RU	1	1698.13	***	18.51
	rep in run REP(RU)	6	172.48	n.s.	
	Desiccant trt. DS	7	4316.39	***	
	RU * DS	7	543.16	n.s.	
	Error	42	1850.27		

Where
*** is significant at 0.1% level
** is significant at 1 % level
n.s. is not significant at the 5% level

APPENDIX 24. Single degree of freedom analyses of variance of the sprout length and weight of Sebago tubers dipped in solutions of different concentration of Hoe-39866.

Experiment	time	Source of variation	df	SS	Pr > F
Combined	sprout length (7 days)	Concentration of desiccant in ppm HOE	1	517.76	0.0001
		Error	62	1353.74	
Combined	sprout length (14 days)	HOE	1	3754.41	0.0001
		Error	62	4242.38	
Combined	sprout length (21 days)	HOE	1	4226.45	0.0001
		Error	62	4015.06	
Combined	sprout length (28 days)	HOE	1	4008.29	0.0001
		Error	62	4622.14	
1st	fresh weight (28 days)	HOE	1	14.3902	0.0001
		Error	30	7.9630	
2nd	fresh weight (28 days)	HOE	1	18.3283	0.0001
		Error	30	21.1951	
1st	dry weight (28 days)	HOE	1	0.3030	0.0001
		Error	62	0.2014	
2nd	dry weight (28 days)	HOE	1	0.7878	0.0001
		Error	62	1.0308	