PREEMERGENCE USE OF METRIBUZIN IN CONTROLLING WEED IN POTATO

(*Solanum tuberosum* L .)

By

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بسم الله الرحمن الرحيم

قال تعالى :

مايفتح الله للناس من رحمة فلاممسك لها ومايمسك فلا مرسل له

(من بعده وهو العزيز الحكيم)

صدق الله العظيم .

Dedication

To my Father and Mother with my Gratitude and Love …

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CONTENTS **Page No.**

List of Table **Page No.**

ABSTRACT

This study was conducted at The River Nile State (northern Sudan) ; Hagar Elassal Province, 150 km, north of Khartoum at Elbsabeer town among the fields of traditional, commercial potato producers , during the growing seasons 2000/2001 and 2001/2002 . The study was indented to evaluate the efficacy of two pre-emergence soil-applied herbicides Metribuzin SC480 at dose of 0.7 kg a.i / fed, 0.5 kg a.i / fed and 0.35 kg a.i / fed and Metribuzin WP 70% at dose of 300 g product/ feddan on weed control , to evaluate their effect on growth and yield of potato (*Solanum tuberosuim.* L .) .

Results of this investigation showed a significant increase in number of leaves per plant and plant height (cm) in both seasons due to the use of herbicides and hand-weeding treatments as compared to the control . Number of branches per potato plant was significantly increased by the use of Metribuzin dose (0.7) kg a.i / fed and by hand-weeding as compared to control . Application of the two herbicides at their different rates and hand-weeding treatments resulted in a great increase in number of branches, shoot fresh weight and oven-dry weight per potato plant (g) compared to control in both two seasons .

The different rates of herbicides MetribuzinSC480 had significantly

increased yield of potato plant (ton / feddan) in both seasons as compared to control and hand-weeded treatment .The two herbicides used gave good control of annual weeds (94.68% — 71.45%) with (99%--84.22) control of broad-leaved weeds and (98.57 — 64.25%) control of graminaceous weeds .

Some annual weeds like *Xanthium brasilicum* vell.; *Ipomoea cordofana* choisy , *Merremia emerginata* (Burm.f.) Hallier f., *Datura stramonium* L. and *Datura innoxia* ; .) which have shown some tolerance to other herbicides like pendimethalin have been efficiently controlled while the perennials weeds like *Cyperus rotundrus* L . and *cynodon dactylon* L). are not affected by the used herbicides though they show leaf yellowing .

بسـم الله الرحمن الرحيم

مـلـخـص الاطـروحة:

اجريت هذه الدراسة بولاية نهر النيل بمحلية حجـر العـسل بمدينة البسـابير بمشروع ود القـب خلال موسمى الشتاء (2001/2000 و 2001 /2002) لاختبار فعالية واخـتيارية مبيدين من مبيدات الحشائش الاختيارية فى البطاطس فى هيئة محلول مركز وبدرة قابلةللبلل وهما متربيوزين 480 محلول مركز ومتربيوزين 70% بدرة قابلة للبلل هدفت الدراسة لمكافحة الحشائش ولمعرفة اثرهما على نمو وانتاج محصول البطاطس ، باستخدام الجرعات 0.35 و0.5 و0.7 كيلوجرام مادة فعالة للمحلول و300 جرام منتج للبدرة/ للفدان .

لقد اتضح من هذا البحث ان هنالك زيادة معنوية فى أطوال النباتات وعدد اوراقها خلال الموسمين وذلك فىكل الجرعات التى استخدمت مقارنة بالشاهد ، وايضا نفس النتيجة فى حالة العزيق اليدوى. لقد زاد عدد الافرع نتيجة المعاملة بالمبيدين وكذلك عند معاملة العزيق مقارنة بالشاهد فى الموسمين . المعاملةبالمبيدين و ايضا بالعزيق ادت الى زيادة فى الوزن الرطب والجاف لنبات البطاطس مقارنة بالشاهد وذلك فى الموسمين . ووجدت زيادة فى انتاجية البطاطس نتيجة المعاملة بجرعات المبيد مقارنة بالشاهد وذلك خلال الموسمين.

لقد ادى استعمال المبيدين الى نقص معنوى عالى فى عدد الحشائش الحولية(94.88-94.68) وكانت نسبة التحكم فى الحشائش عريضة الاوراق (99.28-99.68) ونسبة السيطرة علىالحشائش رفيعة الاوراق (98.57%--97.42%)كما اوضحت الدراسة ان بعض الحشائش المعمرة مثل السعدة والنجيلة قد اظهرت نوعا من التحمل للمبيدين وان الحشائش عريضة الاوراق مثل(الرامتوك والتبر والمطيط(الدرعية) والسكران) قد تم القضاء عليها بسهولة وبصورة ممتازة والتى اظهرت مقاومة لمبيدات اخرى مثل البنداميثالين .

CHAPTER ONE
INTRODUCTION

Potato (*Solanum tuberosum.* L.) is a solanaceous crop introduced into Sudan , in the early forties and has since then , gained an increasing importance as a food crop for the consumers as well as a cash crop for the producers . Its production , in the Sudan is confined to the cooler months of the year (Ali *et al* ., 1994) .

Potato production in Sudan is relatively a novelty agricultural activity which has started in Khartoum State and later spreaded to other parts of the country . There are two growing seasons for potato in the Sudan ; in the low lands , including central and northern Sudan where potatoes are grown in winter (November – March) , the high lands like Jebel Marra (Darfour State and Equatoria in southern Sudan (both elevated areas) , potatoes are grown twice a year : in winter and during the rainy season (June – October) (Geneif and Sadik , 1989) . In the Sudan the estimated area under production is 150000 feddan (Mohamed *et al* ., 1999) .

Potato is considered as one of the major crops grown in the world . It ranks fourth in food production following wheat , maize and rice .It easily tops the list of root crops, followed by cassava , sweet potatoes and yams (Hawkes , 1989). The total world production , is constantly

increasing because of increasing yield and horizontal expansion . The estimated world production is 295,632 million tones and the total acreage is 17949 x 1000 ha (Anonymous , 1998) .

The potato in Sudan greatly suffers from different types of agricultural pests such as insects and diseases e.g. leaf and tuber worms early and late blight , tuber rot diseases ..etc .However the most important obstacle facing production of potato by all means is competition from weeds during the period from planting until its vines begins to fill area between rows (El Tigani , 1977) As potato is grown in the Sudan in winter (short days) and due to the fact that vine growth requires long days for maximum coverage , vine hardly fill the area between the rows under Sudan conditions ; making the need for continuous weed control between rows far more pressing than that in the temperate zones where the crop is grown under long days of spring and summer (El tigani 1977) .

Weeds infesting potato are annuals such as *Datura stramonium* , *Amaranthus graecizans* , *Solanum dubium* , *Ipomea cordofana* , *Chrozophoria plicata* , *Sochus coronutus* , *Brachiaria eruciformis* , *Echinocholoa colonum* species and perennials species such as *Cyperus rotundus* and *Cyndon dactylon* . But the most noxious species is the parasitic weed Haluk (*Orobanche ramosa*) especially at the northern

parts of the Sudan (Ismail ,1979 and Babiker et al. , 1993) . Potato crop shows a reasonable sensitivity to weed competition in the early stage of growth . This indicates that its of great important to maintain the crop in a weed free condition during this early period . Even a number of weeds present at emergence are very small they can still cause a reduction in yield , this fact among others , may justify the use of herbicides due to the possible effect of more timely weed control . (Binswanger and Shetty 1977) .

As potato is usually grown under irrigation and receives high amounts of fertilizers , weed growth is enhanced and as its known that weeds are more efficient than the crop in utilizing these available agricultural inputs so they compete with it for water , light and nutrients thus reducing yield and quality (Eltom ,1987) .

Intensive vegetable farming in the Sudan during winter results in shortage of labors for many operations including weed control . The factors which encourage the use of herbicides in the Sudan , include insufficiency of labors, to properly carry out the optimum number of weeding during the critical period of time and as a result serious crop losses usually occur (Eltigani , 1977) .

The present mechanical method of weed control (hand-weeding or manual weeding) is laborious , expensive and time consuming , hence a

labor saving method of weed control is needed and thus herbicides are a reasonable alternative solution .

Research work on chemical weed control in vegetables has started recently in the Sudan . Information in this area is meager and inadequate especially with reference to potato therefore this investigation was designed to examine the following objective :

1) To study and compare the effect of two pre-emergence soil-applied Herbicides namely , Metribuzin SC480 at different rates on growth and yield of potato crop and Metribuzin WP 70 % at it the recommended dose which is 300g product / feddan.

2) To asses the efficacy of the two Herbicides against the common weeds in potato .

CHAPTER TWO

LITERURE REVIEW

2.1 Damage caused by weeds in Agriculture :

Weeds are thought to cause substantial economic losses in agriculture , because of their reduction in yield and the high cost incurred in their control . Through their competition with crops for water, nutrients , space , and light they lead to serious yield losses . They cause damage by reduction in land value and farm loans , loss of quality of crop produced , reduce human efficiency , increase cost of insect and disease control , problems through aquatic weeds, impair the quality of farm products , reduce the quantity and quality of livestock products, harbor insect pest and diseases ,and increase the cost of labor and equipment. In addition to that some weeds are poisonous to man and animals . Besides the direct and indirect damage caused by weeds to plant and livestock , they are nuisance , they choke waterways , in addition to consume it and generally disrupt efficient farm operations. Weeds cause damage to machinery or clogging of harvest equipments . Some weeds are parasitic on crops (Ahlgren *et. al.* , 1951 ; Crafts and Robbins , 1962 ; King , 1966 , Musik , 1970 ; Kipps , 1971 ; Chapman and Carter , 1976 ; Fletcher and Kirk wood , 1982 ; Turner and Rao , 1982) Besides insect pests and diseases, weeds constitute the main obstacle in agricultural

They are unwanted and undesirable plants which interfere with the utilization of land and water resources and thus adversely affect human welfare (Rao , 1983) . Losses caused by weeds exceed the losses from any other category of agricultural pests . Making a comparison between various pests Rao (1983) found that weeds accounts for 45 % , insect 30 % , diseases 20 % and other pests 5 % .

2.2 Damage Caused by Weeds in Different crops :

A number of factors have encourage increased growth of weeds in recent years , namely the improvement in crop production techniques such as water supply , nutrition , disease and insect control (Klingman G.C 1961) , the use of cultivars with excess foliage and greater specialization by growers with resultant shortening or loss of rotation (Fricke , and Dallyn , S.L 1970) . Dominant weed species tend to change as either cultural practices or chemical usage change and this principal must be recognized and dealt with if successful control programs are to be maintained .Average yield reduction due to weeds was estimated by FAO to be in range of 6-15% for major crops in the Sudan and more than 10% as atypical range (Braun *et al*. 1991) .

According to Parker (1993) the parasitic weed *Orbanche* spp (Halouk) can injure tomato and potato plants directly resulting in yield reduction . He added that hand-pulling is the first approach for light

infestations of Orbanche spp and also to supplement other methods which have given incomplete control. One disadvantage of hand-pulling is strong connection between host and the parasite , the host root system may be disrupted or the crop is completely up rooted when the haluk is pulled out (Parker , 1993) .

According to Braun (1991) in Sudan Haluk heavily parasites some vegetables such as tomatoes , potatoes , carrots and eggplants . He added that recently developments of large scale cultivation of wheat , pulses and direct sown onions , potatoes and tomatoes in addition to scarcity and high cost of labor for removing weeds , necessitated introduction of herbicides .

The degree of weed competition is determined by the weed species infesting the area , density of infestation and duration of infestation (Roa , 1983) .Increase in weed population has a direct effect on reduction in crop yield ; The duration of weed infestation and the time of weed elimination have a great influence on crop growth and yield . Weeds that are not controlled within two or three weeks of emergence usually affect the final yield . Rao (1983) indicated that in many crops , weed infestation during the first 3 to 8 weeks is very critical . In some vegetable crops such as transplanted onion (*Allium cepa* L .) weeds reduced its production by 26 – 48 % , hand-weeding once , 42 days after

transplanting reduce the yield loss to 15 % (Babiker 1986) .

The production of food legumes in Sudan is greatly constrained by weeds which may cause up to 80 % reduction in yield (Solh , 1989) , weeds infestations reduced faba bean yield in Selaim Basin by 50 % (Dawood , 1989) and unrestricted growth of weeds in Hudeiba reduced faba bean yield by 54% (Mohamed *et al* . , 1994) .

Adam (1988) found that leaving weeds unchecked caused up to 62% reduction in onion bulb yield . Adam (1989) also reported that weed competition reduced potato yield by about 50 % . Often weeds are better adapted to the environment than potato crop ,therefore they grow more vigorously , especially during their seedling stages of growth .

2.3 Weed Competition with Potato Crop :

Weeds not only compete with potato crop , but numerous weed species serve as host for insect , disease organisms and nematodes that eventually infest potatoes (Roa, 1983).

Braun *et al*. , (1991) stated that certain parasitic weeds like *Cuscuta* spp. and *Orobanche* spp. can injure potato plants directly . The infestation of these weeds can also interfere with cultural operations and reduce the efficiency of harvest .

Thakral *et al* . (1998) stated that maximum yield of potato was

obtained when plots are kept weed-free , followed by weeding at 4 and 6 weeks after planting . However they added that weeding at 2 weeks resulted in a significant reduction in tuber yield .They also found that in unweeded control plots the tuber yield of potato was reduced by 40 – 43% .

A range of weed species infest the potato crop . Some of them are annuals and other are perennials . However , the most serious weed attacking potato and causing a drastic reduction in productivity is the Broom-rape (*Orobanche ramose* L.) , Haluk as known in Sudan . Broom-rape is a real obstacle facing production of potato and tomato crops in tropical and subtropical areas allover the world . *Orobanche* spp. arise as a noxious parasitic weed in vegetables , legumes , and sunflowers in the northern Africa and in the Near and Middle East . However , the center of distribution of *Orobanche ramosa*. is Mediterranean , Western Asia and East Europe (Labrada et al ., 1996 ; Musselman and Borg , 1996 ; Parker , 1993 ; Parker and Borg , 1986 ; Kranz et al . 1977) . They added that species of the genus *Orobanche* are parasitic plant with specific host range , viz . : *Orobanche crenata* is a major pest of faba beans and attacks some other crops in the Leguminosae , Composite and Umbelliferae , *Orobanche. cernua* has more distinct races which attack sunflowers and members of the family Solanaceae ; *Orobanche ramosa*

and *aegyptiaca* attack a much wider range of crops over a wide geographic range but the most important are potatoes , tomatoes and tobacco , various members of Cucurbitaceae . *Orobanche minor* has a very wide host range but serious economic damage is restricted mainly to clovers (*Trifoluim* spp) in Leguminoceae.

Member of this genus are holoparasites, lacking chlorophyll with stem bearing simple spike or raceme of flowers and with small scales instead of leaves . Flowers are hermaphrodite and fruits are capsules (Braun *et al* .1991) .

According to Parker (1993) *Orobanche ramosa* causes some of the most acute problems of any *Orobanche* species, especially on tomato, which it is able to build up extremely rapidly ,causing serious reductions of yield and precluding the economic production of tomato and number of Solanacous vegetables crops such as potato and eggplant .

Hershenhorn *et al* (1996) stated that pepper roots stimulated the germination of 22% - 26% of nodding broom-rape seeds but without the formation of parasitic attachment , where as tomato and potato roots exudates stimulated germination of less than 10 % of the seeds but the plants were heavily damaged by the parasite . Also the exposed conditioned seeds of *Orobanche agyptiaca* under aseptic conditions were stimulated and germinated by roots of faba bean , maize , tobacco and

tomatoes (Croes et el. , 1994) . Americanos and Vouzounis (1995) found that *Orobanche agyptiaca* infesting cabbage can cause complete crop failure by preventing the plants from forming heads . The seeds of Orobanche are similar in size to those of striga mostly about 0.3x0.2 u and weighting 3-6 u . They also have pattern of raised ridges, but the pattern is coarser . Parker (1993) and Jurgen *et al* .(1977) showed that the optimal temperature for germination ranges from 20-25 C for most species of Orobanche , and the seeds have a life span of from two to twelve years, at favorable temperature germination of the main species normally takes 2-3 days Parker (1989) .

Parny (1989) mentioned that seed production of *Orobanche ramosa* under favourable conditions can reach 400000 – 600000 seeds per rape plant causing up to 85% -- 90% crop loss .Gebre *et al* (1987) indicated that *Orobanche* spp. in sunflower emerged in 104-119 days after sowing the crop , matured almost immediately after flowering (30-48 days after emergence) and reach infestation levels of 22000 -208000 plants / ha . Light is inhibitory to germination of O.*ramosa* .Labarda and Perez (1988) mentioned that germination of seed exposed to sun light for 1-4 hours is less than or equal to 4% compared with 73 % germination of non-exposed seeds .

2.4.1 Weed Control in Sudan :

Agriculture is the main occupation in the Sudan , more than 80% of the population lives in rural areas and is engaged in a way or another in agricultural production. It is of great importance in the national economy providing food , feed ,foreign exchange ,fuel and employment .

With the ever rising demand for food to feed a rapidly growing population ,crop yield and production must be increased through adoption of good husbandry technique including weed control .

Accordingly , weed control is one of the most important practice in crop production . It occupies a high proportion of the farmer's time and consume large proportion of his income . Until recently weeds have been controlled by ploughing and repeated hand-weeding operations carried by casual labor ,the farmer and his family . In the 1960's labor for hand-weeding was abundant , wages were low and the cost of weeding constitute only a small proportion of the cost of production . In the recent years the available labor was unable to cope with the intensive weed growth during the early stages of growth nor carry out optimum number of weeding and serious crop losses are usually encountered . The scarcity of labor due to expansion of cropped areas , the intensification and diversification of cropping , the continued movement of younger

generation to urban areas , and abroad ,the attendance of farmers sons and daughter today schools and the reluctance of farm labor to do the tedious hand weeding operations have all led to considerable rise in the cost of hand weeding and to a steady increase in annual and perennial weed infestations such a situation encourage the registration and use of herbicides in cotton , groundnuts , sorghum , sugar cane , tree crops and vegetables .

2.5.2 Classification of Herbicides :

According to Rao (1983) herbicides are classified in accordance of the method of application into two large groups soil-applied and foliage-applied herbicides .They are also classified according to time of application into :

2.4.2.2 Pre-plant Herbicides :

These herbicides applied to the soil before seeding of the crop ; some types may be incorporated into the soil after application .

2.4.2.2 Pre-emergence Herbicides :

These are applied following seeding of the crop , pre-emergent to both the crop and weeds .

2.4.2.3 Post-emergence Herbicides :

These are applied following emergence of the crop or weeds or

both. All herbicides applied as pre-emergence to the crop are considered as soil-applied group and those applied post-emergence to the crop are included under the foliage-applied group .

Since herbicides used in this investigation are soil-applied ones , it is Worth to mention some of the important characters of such herbicides .

2.4.3 Classification of Soil-applied Herbicides :

Anderson (1977) stated that on the basis of chemical structure ,soil applied herbicides are classified into organic and inorganic compounds . Inorganic compounds include herbicides such as sulphate , nitrate , borate ,chlorate ,….etc . Most of these chemicals were used as sterilant .

Organic compounds include , aliphatic ,amides , benzoic carbamates , dinitroaniline , benzonitrites , nitrophenol , triazines , sulfonyl ureas , uracils and diphenyl ethers .

2.4.4 Factor Influencing Activity of soil-applied Herbicides :

After a herbicide reaches the soil , it is subjected to various reactions with soil and environmental factors . Most important factors reviewed to influence soil- applied herbicides were the following :

2.4.5.1 Edaphic Factors :

2.4.5.1.1 Soil organic Matter and Clay content :

Soil organic matter is the most significant factor affecting

adsorption , desorption and phytotoxicity . These are considered as the most important factors reducing phytotoxicity of dinitroaniline herbicides it can be a major reason of wide variation in plant response to a given herbicide concentration in the soil (Elamin , 1991) .

Upchurch and Nasan (1962) examined 12 different herbicides and found that the activity of all of them was highly correlated with soil organic matter content . Sarpe *et al* . (1977) reported that on 3 soil types (Chernozem , Podzolic and reddish brown) with trifluralin , imazethapyr , pendamethalin and alachlor applied to pea and soybeans followed by cultivation of winter wheat , sunflower , sugar beet , maize and mustard (sinapis) . The effect on sunflowers was closely related to the soil type from very strong inhibition on the Podozolic to no effect on chernozoem . Sugar beet was the most sensitive crop , even two years after imazethapyr application . According to Applebly (1985) organic matter can be a major reason for a wide variation in plant response to a given herbicides concentration .

2.4.5.1.2 Soil pH :

Corbin and Upchurch (1967) showed that soil PH may directly or indirectly influence the activity and detoxification of herbicides by affecting ionic or molecular characters of the chemical , the ionic of soil

colloids , the cataion exchange capacity and the inherent capacity of microbial population to attack a given herbicides . Blair and Martin (1988) indicated that chlorsulfuron phytoxicity was found to increase as soil PH increase and reaches its maximum at PH 6.9 . Roa (1983) reported that the degradation of atrazine occurred more rapidly when the surface PH was less than 5.0 compared with a ph. greater than 6.5 .

2.4.5.1.3 Soil Moisture :

Savage (1978) showed that degradation of pendimethalin proceeded more under flooded anaerobic conditions than under flooded aerobic conditions . According to Savage and Jordan (1980) a significant increase in initial losses of trifluralin with increase in moisture content at the time of herbicide application, also high moisture content resulted in blocking the active sites for trifluralin adsorption and this in turn resulted in increasing the rate of degradation (Hollist and Foy ,1971 ; Boldt and Barrett 1989) indicated that an increase in soil moisture coupled with a decrease in soil temperature increased chloroacetamide phytotoxicity to corn seedlings .

2.4.5.4 Nutrient Status of the Soil :

High level of phosphorus enhance the action of amitrole , diuron simazine and atrazine (Selman and Upchurch , 1970 ; Sun and Adam , 1971) . Stolp and Penny (1973) reported that high levels of phosphorus

increase the phytotoxicity of diuron .According to Elamin the limited evidence from field experiments suggested that the effect of soil nutrients level on herbicides activity were small compare with those from other soil properties .

2.4.5.1.5 Soil Texture and Structure :

Carbamates and urea herbicides are considerably less toxic to weeds in a heavy organic soil than in to the same weeds in light soil (Harty ,1964) . Braverman *et al*. (1986) found that degradation rate of metolachlor (Dual) was more rapid in silty loam soil than silty clay soil also degradation of DCPA was observed to be fast in medium soil texture (Choi *et al*,1980).

2.4.5.2 Climatic Factors :

Light , temperature , and moisture are the main climatic factors to be considered when dealing with soil-acting herbicides .

2.4.5.2.1 Light :

Under field conditions observation of photodecomposition of sun light for dicamba , dinitramine , picloram , trifluralin and prometryn was reported by Hahan et al. (1969) . Savage and Jordan (1980) indicated that shading from sun light greatly reduce the loss of fluchloralin and pendimethalin as compared with exposure to full sun light .

2.4.5.2.2 Temperature :

According to Elamin (1991) both air and soil temperature influence the performance of soil acting herbicides .Temperature influences herbicides activity in many ways and interacts with other environmental factors . It might also influences plant response by affecting herbicide availability in the soil , humidity gradient and there fore , physiological processes . Viger *et al*.(1991) who study the influence of temperature in metolachlor observed that injury to corn grown under cool temperature (13/12C) day/night is more than when grown under warm temperature (30/21C).

2.4.5.2.3. Moisture :

Herbicides applied to soil surface need to be removed into the soil by irrigation water or rainfall (Harty,1976). According to Savage and Jordan (1980) stimulated rainfall on the first day sampling period resulted in significant increased dissipation of fluchloralin and pendimethalin. Kern *et al* (1975) indicated that high soil moisture during periods of active plant growth is favorable for rapid root uptake of cyanazine which cause injury to corn .

2.4.6 Properties of Soil-applied Herbicides :

Elamin (1991) indicated that the most important properties to be considered are :

2.4.6.1 Lipophilicity :

Herbicides which are not electrically charged are bound to the soil according to their oiliness i.e polar compound will associate with soil organic matter in preference to water . Very oily herbicides such as trifluralin are strongly bound in the moist soils .Such strongly bound compounds are usually volatile and work by evaporation and move to weed shoots as a vapor . Loss of such compounds by evaporation from the soil surface can be a problem , and that is why they are mechanically incorporated at application (Elamin 1991) .

2.4.6.2 Water Solubility and Mobility in the Soil :

Mobility of herbicide within the soil either in aqueous phase or in gaseous state is a significant factor that will influence its bioactivity however , it has been concluded that the aqueous movement of dinitroaniline has almost no effect on their herbicide efficacy . Numerous investigators have found most of the dinitroaniline herbicides move only slightly in leaching studies , remaining essentially where they were applied .They have low water solubility and their affinity to lipophilic substances , contribute to this negligible mobility (Elamin ,1991) .

2.5.6.3 : Electrical Charge (Ionization) :

Elamin , (1991) stated that all dinitroanilines are nonionic . They are rapidly adsorbed by lipophilic substances such as organic matter and clay cloid .

2.5.7 . The Fate of Soil-applied Herbicides in the Soil :

As it was stated by Roa (1983) herbicides reaching the soil become dissipated or removed in the following ways : uptake and metabolism by plants , volatilization , photodecomposition , adsorption , leaching ,degradation by soil microorganisms , and chemical degradation .

2.5.7.1 Uptake and Metabolism by Plants :

O'donovan and Prendeville (1976) stated that soil applied herbicides are generally taken readily from the soil through the roots or coleoptiles of young seedling and transported to the foliage .The site of uptake of dinitroanline is the shoot for monocots and the hypocotyls hook for dicots (Elamin , 1991) Where as the site of action for them in monocots the coleoptiles. High level of relative humidity increased dalapon uptake into the plants by hydrating the cuticle (Jordan , 1977) .

2.5.7.2 Volatilization :

Savage and Jordan, (1980) stated that volatilization of herbicide from the soil is controlled by many variables including soil moisture content and direct sunlight . However , the extent of volatilization vary with different herbicides . According to Hahn *et al* , (1966) losses from volatilization become much greater with compounds which have higher vapour pressures . Walker and Bond (1977) stated that significant losess of pendimethalin from surface applications may occur through

volatilization although these are greatly reduced when the soil surface is dry . This herbicide is more persistent when incorporated than when applied th the soil suface.

2.5.7.3 Photodecomposition :

Photodecomposition constitutes a major loss of herbicidal activity under field conditions . Moilanen and Crosby (1972) indicated that the pathways of propanil photodecomposition were replacement of chlorine substitutes by hydroxyl group , formation of propionamide , replacement of chlorine substituents by hydrogen and hydrolysis of amides . Kochany and Maguire (1994) reported that sunlight degradation of metolachlor (Dual) was faster than degradation by chemical processes but it was relatively slow process .

2.5.7.4. Adsorption :

Rao (1983) stated that adsorption is a major factor affecting the persistence and behaviour of herbicides in the soil . It controls the availability of herbicide molecules to the soil solution , affects the movement of herbicides in the soil, and regulate s their availability to plants and rate of decomposition in the soil . Strongly adsorbed herbicides decompose slowly . Decomposition is rapid in the case of herbicides which are more freely available in soil solution .

2.5.7.5 Leaching :

Hartley , (1976) mentioned that the extent to which a soil applied herbicicde moves into the soil with water largely determines its efficiency and persistence , so herbicides which are applied to the soil surface need to be moved into the soil by rainfall or irrigation water ,however ,further downward movement can result in decrease weed control efficiency and damage deep rooted crops (Koren ,1972) .

Horowitz *et al* (1974) showed that different herbicides vary in their mobility in the soil. Diuron and Linuron are considered as moderately mobile. Erichson (1965) stated that adsorption of herbicides by soil organic matter and onto the clay minerals reduces or some times inhibits leaching . Monuron leaching was found to be greatly reduced in soils containing low sand , high clay and high organic matter . Movement of triazines was found to decrease with increase in soil organic matter (Nearpass , 1965) .

Herbicides loss from the soil by leaching , is influenced by soil drainage ,the solubility of the herbicide and the lack of adsorption , these are important factors in the loss of phenoxykanoic acids and the chlorinated aliphatic acids from the soils (Flecher and Kirkwood , 1982) .

2.5.7.6 Degradation by Soil Microorganisms :

Destruction of soil-applied herbicides by microorganisms may occur rapidly if conditions are proper for their growth in the soil . Chakaborty *et al*. (1995) reported that a soil fungus *Fusarium solani* isolated from the soil by enrichment culture techniques , degraded the herbicide oxadiazon (Ronstar) by a cometabolic process . Some herbicides must be modified by microorganisms before they are toxic or before they will injure plants . Pendimethalin degradation by several soil fungi proved a partial N-dealkylation followed by ring hydroxylation , nitrogen group reduction and complete N-de-alkylation (Brown *et al*., 1990) .

Liu *et al*. , (1991) found that degradation was the major transformation mechanism of metalochlor by three soil fungi *Streptomyces* sp; *Phanerochaetae chrysosporium* and *Rhizoctonia proticola* .

2.5.7.7. Chemical Decomposition :

Anderson (1977) stated that soil-applied herbicides undergo a range of chemical reactions which lead to oxidation , reduction , hydrolysis or formation of more complex compounds .

The process of chemical decomposition needs a higher energy than needed by biological degradation and it is highly dependent on temperature (Burschel , 1961) hydrolysis of the herbicide cyanazine in acid and alkaline solution was observed by Brown *et al* . (1972) .

Zimdahl and Gwynn ,(1977) stated that some herbicides degraded in a sequence of dealkylation and reduction reactions .They also found that under aerobic conditions dealkylation predominates , where as under anaerobic conditions reduction predominates .

2.5.8 Selectivity of Soil-acting Herbicides :

According to Gwynne and Murray (1985) the term selectivity refers to as the situation where herbicide reaches and destroys a vital function in one Plant (weed) or group of plants (weeds) and doesn't cause simultaneous damage to another (crop) .Selectivity of a soil-applied herbicides could be a chieved : (1) By variation in position of the roots or other organs taking up herbicide in relation to the location and availability of the herbicidein the soil . (2) By differential absorption of chemical .(3) Following uptake , by differential translocation , different rates of herbicide metabolism or by selective effects on metabolic systems at the site of action .

2.5.9 The Herbicide Used in the Present Investigation :

The used herbicides in this research work are : Metribuzin SC480 and Metribuzin 70 % WP ;

Molecular formula : C H N O S

Structural formula :

Common name : metribuzin .

Trade mark : Sencor (Bayer) ; Lexone (Du Pont) ; Mistral (Feinchemie Schwebda) .

Chemical family : 1,2,4 triazinone .

Chemical name : 4-amino-6-(1,1-dimethylethyl)-3-(methylthio)=1,2,4-triazin-5-(4H)-one .

Metribuzin is atriazine systemic selective herbicide discovered and developed by Bayer ; Du Pont and Rallis as a pre-and-post emergence for grasses and broad-leaved weeds control in many crops including potatoes , tomatoes , alfalfa ,soya beans ,sugar cane , maize and cereal at 0.35-0.7 kg a.i / ha . It is phytoxic to many crops including crucifers , cucurbits , lettuce , onions , sugar beet, sunflowers , flax ,strawberries , sweet potatoes and tobacco .

Photodecomposition on soil surface and in aqueous solution is an important process for the degradation of metabolism in the environment . Metribuzin is rapidly degraded in the soil ,microbial breakdown is the major mechanism of loss . Degradation involves

deamination , followed by further degradation to water-soluble conjugates.

Metribuzin acts as electron transport inhibitor and its selectivity is due to metabolism within the plant .

Following oral administration in mammals 98 % elemination occurs within 96 hours ,about equally in the urine and faeces . NOLE : (2y) for rats and dogs 100 , mice c. 800 mg / kg diet , ADI : 0.013mg / kg b.w toxicity of a.i class III .

CHAPTER THREE
MATERIALS AND METHODS

This experiment was conducted at River Nile State (northern Sudan) ; Hagar Elassal province 150 km ,north Khartoum at Elbsabeer town among the fields of traditional, commercial potato producers . during the growing seasons 2000/2001 and 2001/2002 . The experimental area was located at the Nile bank were the soil is classified as clay loam , Ph was about 8.2 and the ECE value was 33 meq /100 g .

Seed tubers of the potato cultivar's Alpha , imported from Holland were used . Seed were planted on the first of December for both seasons on ridges 70 cm apart with 25 cm spacing between plants . Plots of 3 X 7 meters were used and each plot consisted of four ridges oriented east-west .

Ten weed control and weed evaluation treatments were applied to the plots in the following manner :

1) Metribuzin SC480 at rate of 0.35 kg a.i / fed.
2) Metribuzin SC480 at rate of 0.35 kg a.i / fed. plus hand-weeding .
3) Metribuzin SC480 at rate of 0.5 kg a.i / fed.
4) Metribuzin SC480 at rate of 0.5 kg a.i / fed. plus hand-weeding
5) Metribuzin SC480 at rate of 0.7 kg a.i / fed
6) Metribuzin SC480 at rate of 0.7 kg a.i / fed plus hand-weeding

7) Metribuzin WP 70 % 300 g product/ feddan (recommended dose)

8) Metribuzin WP 70 % 300 g product / feddan plus hand-weeding the recommended dose) .

9) Hand-weeding Control .

10) Weedy Check (unweeded) .

All herbicide rates were applied as pre-emergence surface spray 4 days after planting using a knapsack sprayer , at spray volume of 350 L / fed . The experimental area was fertilized with Urea at 79 kg / fed as a side dressing applied six weeks after planting . Irrigation and insect control were carried out as required .

hand-weeding carried out in treatments 2,4,6,8, and 9.The first one was carried out four weeks after planting , while the second hand-weeding and the earthing up operation were done together eight weeks from planting . The experimental design used was the randomized complete block design with four replications.

3.1 Data Collection :

Data on the effect of various weed control treatments on plant height , number of leaves / plant , number of branches/ plant , shoot fresh weight / plant , shoot dry weight / plant , weed evaluation and crop yield were collected .

3.1.1 Data on the crop :

One and a half month from application of the two herbicides the following were recorded :

Five potato plants were randomly taken from the two inner rows of each plot for determination of the following :

1. Plant height (cm) .
2. Number of leaves per plant .
3. Number of branches per plant .
4. Shoot fresh weight per plant (g) .
5. Shoot oven-dry weight per plant (g) .

Whole plants , fresh and dry weights , were measured on March 16^{th} , for both seasons , that is to say two weeks prior to harvest time . From each plot , five hills were taken at random from the two inner rows .The plants from each treatments were bulked together , washed and then fresh weighed , air dried for a week , oven dried at 70 C for 48 hours in forced – air oven then weighed to determined the dry weight of each sample .

3.1.2 Data on Yield : The experiment was terminated and tuber were harvested during the first week of April for both seasons after haulm yellowing and

beginning of its death . The yield of 20 plants from the center of each experimental plot was taken and calculated into tons per feddan for each treatment .

3.1.3 Data on Weeds :

Weed control was determined by two weed counts, and by measuring the oven dry weight of the second weed count in a square meter area . the first one was done 5weeks after application and by measuring the oven dry weight of the second count in a square meter area . The first weed counts were evaluated , for both seasons, seven weeks from planting and the second counts one day prior to harvesting . The species and number of weeds in square meter area per plot were recorded.

Data obtained , from the crop and weeds were subjected to analysis of variance and means were separated using Duncan's Multiple Range Test (DMRT) and the least Significant Difference test (LSD) . Percentage data was Arcsine transformed prior to statistical analysis

Chapter Four

Chapter Four

RESULTS

It may worth reporting that the rates of application of herbicide treatments were : 0.7 kg a.i / fed , 0.5 kg a.i / fed and 0.35 kg a.i / fed for Metribuzin SC 480 , and 300 g product / feddan for Metribuzin WP 70% .

4.1 Effect of Herbicides Treatments on Some Potato Growth Parameters :

4.1.1 Effect on Plant Height (cm) :

Plant height (cm) for potato crop , was significantly ($P < 0.05$) increased by herbicide treatments at their different rates and by hand weeding as compared to the unweeded control in both seasons. Metribuzin dose 0.7 kg a.i / fed with supportive hand-weeding gave the greatest potato plant height while all the other treatments gave potato plant height with no significant different between them . The minimum plant height value was obtained from the cropped weedy check treatment as presented in table (1) .

4.1.2 Effect on Number of leaves per-plant:

Metribuzin dose 0.7 kg a.i / fed with and without hand-weeding had significantly gave the greatest number of leaves per potato plant compared to other the other treatments , which gave number of leaves per potato plant values with no significant difference between them yet

greater than cropped weedy check treatment values as shown in table (2) .

4.1.3 Effect on number of branches / Plant :

The cropped weedy check gave significantly the lowest value of number of branches per potato plant compared to other treatments that tended to give number of branches with no significant different between them in both seasons as presented in table (3) .

4.1.4 Effects on Shoot fresh Weight / Plant (g) :

Data in table (4) indicate that there were no significant differences between treatments as regards shoot fresh weight (g) per potato plant in both two seasons . However , Metribuzin SC480 dose 0.35 kg a.i / fed without supportive hand-weeding tended to give significantly ($P < 0.05$) the highest fresh weight value compared to all other treatments . Only the cropped weedy check appeared appeared to produce the lowest value of plant fresh weight (g) compared to all other treatments in both two seasons .

4.1.5 Effects on Shoot Oven-dry Weight / Plant (g) :

All treatments tend to give shoot oven dry weight per plant values significantly higher than the cropped weedy check , the low dose of 0.35 a.i kg of Metribuzin SC480 without hand-weeding gave significantly the highest value of shoot oven dry weight in both seasons compared to all other herbicides treatments .

4.2 Weed Evaluation:

4.2.1 Effect on Weed Biomass (g / m2) :

The effect of herbicides treatments on weed biomass showed a significant reduction in total weed biomass , in both seasons , as compared to the un weeded control five weeks from herbicides application.

Weed biomass was reduced from untreated value of 52.89 g / m2 to an average of 1.082 g / m2 and from 45.51 g / m2 to average of 1.46 g / m2 in the first and second season respectively table (7).

The total effect of the two herbicides on weed biomass as measured by the mean of individual herbicide and the overall mean of herbicides indicates a significant ($P < 0.05$) reduction in weed biomass in the experimental site due to the use of herbicides as compared to the unweeded control in both seasons . Table (7) .

4.2.2. Effect of Herbicides Applications on percentage Weed Control

4.2.2.1. Effect on Grass Weeds Control Percentage :

As shown in Table (6) both herbicides at their different dosages used and the hand-weeded control check resulted in a significant ($P< 0.01$) reduction in annual grass weeds population in both seasons compared to the cropped weedy check . The best result were achieved with Metribuzin SC480 dose 0.35 kg a.i / fed then came 0.5 kg a.i / fed ,

Metribuzin SC480 dose 0.7 kg i.a / fed , followed by Metribuzin70% WP 300g product /feddan, a.i / fed respectively .The least population reduction in annual grass weeds population was obtained with hand-weeding control.

4.2.2.2. Effect on Broad-leaved Weeds Control :

The hand-weeding control and the herbicides treatments had significantly ($P < 0.01$) reduced broad-leaved weeds population as indicated by percentage weed control in both seasons as compared to the un weeded control five weeks from application . However the high rates 0.7 kg a.i / fed, 0.5 kg a.i / fed and 300 g product / feddan gave the best percentage control of the broad-leaved weeds as presented in table (6) .

4.2.2.3. Effects on Total Weeds:

The hand-weeded control treatment and the herbicide treatments at their different rates had significantly ($P<0.01$) increased the total percentage weed kill as compared to the un weeded control in both seasons . Total weeds control percentage ranging from (94 % to 71%) as shown in Table (6 **).** However **,** Metribuzin SC480 dose 0.35 kg a.i / fed gave the best percentage of total weed control then came the doses 0.7 and 0.5 kg a.i / fed respectively . The hand-weeded control treatments and the total effect of herbicides on the percentage weeds control as

indicated by means of each herbicide treatments and overall mean of herbicides, showed a significant ($P < 0.01$) increase percentage of total weed control as compared to un weeded control.

The same pattern of weed populations distribution appeared in the second weed count, in the both two seasons . It was also observed that weed population increased towards the end of the season, which it is likely to occur as weeds in the herbicidal trials tend to increase towards the end of the season as the residual amount of herbicides become decomposed .

4.2.3 Weed species :

Table (9) shows the weed species surviving after the application of the treatments in the experimental area . These were recorded seven weeks from planting and at the end of the first and second season (2000/2001- 2001/2002) respectively . The annual weed flora of the experimental area consist of about (23) species of both grasses and broadleaved weed such as :

1) *Amaranthus graesizans* .

2) *Datura stramonium* .

3) Datura innoxia .

4) Echinochloa colona .

5) Ipomoea cordofana .

6) Solanum dubium .

7) Echium rauwolfii .

8) Hibiscus trionum .

9) Xanthium brasilicum .

10) Sonchus oleraceus .

11) Sonchus cornutus .

12) Ipomoea sinensis .

13) Sorghum arundinaceum .

14) Dichantium annulatum .

15) Cynodon dactylon .

16) Brachiaria eruciformis .

17) Rhynchosia mimnonia var memnonia

18) Chrozophora plicata .

19) Cyperus rotundus .

20) Heliotropium supinum .

21) Agremone mexicana .

22) Amaranthus viridis .

23) Hibiscus lobatus .

4.3.1. Yield :

Table (8) shows the average total yield for each treatment. For both seasons differences between some treatments as regards total yield were statistically significant for both two seasons. Almost all the

treatments gave significantly high yield than the cropped weedy check . The highest yield was obtained with Metribuzin SC480 dose 0.35 kg a.i / fed followed by Metribuzin SC480 dose 0.7 kg a.i / fed ,then came Metribuzin SC480 dose 0.5 , Metribuzin WP 70% dose 300g product / feddan respectively.The hand-weeding gave the lowest yield yet significantly higher than cropped weedy check treatment's yield. Hand-weeding when applied to herbicide treated plot resulted in improved yield but with no significant difference compared with yield of unweeded herbicide treatments .

Table (1) : Effect of Herbicide Treatments on Plant height (cm)

(2000/2001 , 2001/2002) .

Treatments	Herbicide Dosage kg a.i / feddan	Plant height (cm)	
		2000	2001
Met.SC.480	0.35	27.60 c	26.65 c
Met.SC.480	0.35 + weeding	28.27 bc	27.20 c
Met.SC.480	0.5	28.40 bc	26.15 c
Met.SC.480	0.5+weeding	29.45 bc	27.04 c
Met.SC.480	0.7	30.55 ab	30.55 ab
Met.SC.480	0.7+weeding	31.22 a	31.22 a
Met.WP 70 %	300 g product	26.65 c	28.40 bc
Met.WP 70 %	300 g product + weeding	26.85 c	28.23 c
Hand-weeding control	-	26.25 c	27.83 c
Cropped Weedy check	-	14.55 d	13.45 d
L.S.D 5% SE		0.05 0.75	0.05 0.7560

Treatment means followed by the same letters , are not significantly different according to Duncan's Multiple Range Test .

Table (2) *:* <u>Effect of Herbicide Treatments on Number of leaves / plant (2000/2001 , 2001/2002) .</u>

Treatments	Herbicide Dosage kg a.i / feddan	Number of leaves /plant	
		2000	**2001**
Met.SC.480	0.35	97.24 b	96.21 b
Met.SC.480	0.35 + weeding	98.27 b	97.22 b
Met.SC.480	0.5	97.91 b	98.47 ab
Met.SC.480	0.5+weeding	99.9 ab	96.81 b
Met.SC.480	0.7	100.0 ab	98.82 ab
Met.SC.480	0.7+weeding	103.4 ab	102.3 a
Met.WP 70 %	300 g product	98.43 b	97.38 b
Met.WP 70 %	300 g product + weeding	98.47 b	95.70 b
Hand-weeding control	-	96.73 b	97.36 b
Cropped Weedy check	-	56.69 c	55.88 c
L.S.D 5% SE		0.05 0.266	0.05 1.33

Treatment means followed by the same letters , are not significantly different to Duncan's Multiple Range Test .

Table (3) *:* Effect of Herbicide Treatments on Number of branches / plant (2000/2001 , 2001/2002) .

Treatments	Herbicide Dosage kg a.i / feddan	Number of branches / plant	
		2000	2001
Met.SC.480	0.35	18.35 ab	15.45 de
Met.SC.480	0.35 + weeding	17.90 ab	15.27 de
Met.SC.480	0.5	17.17 bc	16.15 cd
Met.SC.480	0.5+weeding	16.35 cd	16.10 cd
Met.SC.480	0.7	18.10 ab	18.10 a
Met.SC.480	0.7+weeding	19.13 a	17.52 ab
Met.WP 70 %	300 g product	16.20 cd	16.85 bc
Met.WP 70 %	300 g product + weeding	17.17 bc	17.05 abc
Hand-weeding control	-	15.63 d	14.52 e
Cropped Weedy check	-	6.563 e	5.483 f
L.S.D 5% SE		0.050 0.3975	0.050 0.381

Treatment means followed by the same letters , are not significantly different to Duncan's Multiple Range Test .

Table (4) : Effect of Herbicide Treatments Shoot Fresh Weight (g)

(2000/2001 , 2001/2002) .

Treatments	Herbicide Dosage kg a.i / feddan	Shoot fresh weight (g)	
		2000	2001
Met.SC.480	0.35	33.84 a	32.81 a
Met.SC.480	0.35 + weeding	32.28 b	30.90 b
Met.SC.480	0.5	31.86 b	30.45 b
Met.SC.480	0.5+weeding	31.97 b	29.50 bc
Met.SC.480	0.7	31.55 bc	30.45 b
Met.SC.480	0.7+weeding	30.92 bc	31.20 b
Met.WP 70 %	300 g product	29.46 d	29.85 bc
Met.WP 70 %	300 g product + weeding	30.26 cd	29.15 bc
Hand-weeding control	-	29.23 d	29.85 bc
Cropped Weedy check	-	6.740 e	5.637 e
L.S.D 5% SE		0.050 0.4298	0.050 .04353

Treatment means followed by the same letters , are not significantly different to Duncan's Multiple Range Test .

Table (5) : Effect of Herbicide Treatments on Shoot oven dry weight (2000/2001 , 2001/2002)

Treatments	Herbicide Dosage kg a.i / feddan	Shoot oven dry weight (g)	
		2000	2001
Met.SC.480	0.35	10.34b	11.34a
Met.SC.480	0.35 + weeding	10.23b	9.288b
Met.SC.480	0.5	9.650c	8.550c
Met.SC.480	0.5+weeding	9.230d	8.202d
Met.SC.480	0.7	9.39d	9.155b
Met.SC.480	0.7+weeding	8.722d	7.238f
Met.WP 70 %	300 g product	7.327h	6.275h
Met.WP 70 %	300 g product + weeding	7.750g	6.645g
Hand-weeding control	-	8.288d	7.577f
Cropped Weedy check	-	3.753i	2.652i
L.S.D 5% SE		0.050 0.1118	0.050 0.1012

Treatment means followed by the same letters , are not significantly different to Duncan's Multiple Range Test .

Table (6) : Effect of Herbicide Treatments on control of grass, broad-leaved and Total weeds (expressed as % of that in the untreated-control (2000/2001 , 2001/2002) .

Treatments	Herbicide Dosage kg a.i / fed	Grass Weeds Control (%)		Broad-leaved Weeds Control (%)		Total Weeds Control (%)	
		2000	2001	2000	2001	2000	2001
Met.SC480	0.35	98.57a	97.42a	93.75c	92.25c	94.88a	94.68a
Met.SC480	0.35+weedin-g	97.46a	96.31a	93.50c	92.22c	94.55a	94.42a
Met.SC480	0.5	82.85b	82.54b	96.87b	96.24b	87.17b	86.58b
Met.SC480	0.5+weeding	82.43b	82.33b	96.77b	96.35b	87.25b	86.44b
Met.SC480	0.7	71.42c	70.52c	99.68a	99.28a	89.75b	88.64b
Met.SC480	0.7+weeding	71.31c	70.22c	99.77a	99.43a	89.75b	88.66b
Met.WP70%	300 g product	65.71d	64.25d	84.22d	84.37d	71.79c	71.79c
Met.WP70%	300 g product+weeding	65.60d	64.30d	84.34d	84.32d	71.50c	71.45c
Hand-weeding control		100.0e	100.0e	100.0e	100.0e	100.0e	100.0e
Untreated control	-	00.00f	00.00f	00.00f	00.00f	00.00f	00.00f
L.S.D 1%							

Treatment means followed by the same letters , are not significantly different according to Duncan's Multiple Range Test .

Table (7) : **Effect of Herbicide Treatments on average weed boimass assessed at the end of the two seasons (2000/2001 , 2001/2002)**

Treatments	Herbicide Dosage kg a.i / feddan	Weed dry weight g / m2	
		2000	2001
Met.SC.480	0.35	1.082 c	1.4625 c
Met.SC.480	0.35 + weeding	1.072 c	1.4825 c
Met.SC.480	0.5	1.475 c	1.8413 c
Met.SC.480	0.5+weeding	1.572 c	1.6375 c
Met.SC.480	0.7	5.113 b	7.122 b
Met.SC.480	0.7+weeding	5.500 b	7.50 b
Met.WP 70 %	300 g product	6.25 b	5.315 b
Met.WP 70 %	300 g product + weeding	6.45 b	5.420 b
Hand-weeding control		7.78 b	6.56 b
Cropped Weedy check	-	52.89 a	45.51 a
L.S.D 5% SE		0.050 1.769	0.050 0.8319

Treatment means followed by the same letters , are not significantly different to Duncan's Multiple Range Test .

Table (8) : **Effect of Herbicide Treatments on average total yield of potatoes in tons / feddan (2000/2001 , 2001/2002) .**

Treatments	Herbicide Dosage kg a.i / feddan	(Yield ton/ feddan)	
		2000	2001
Met.SC.480	0.35	12.60 a	12.45 a
Met.SC.480	0.35 + weeding	08.86 b	8.75 b
Met.SC.480	0.5	10.04 b	10.05 b
Met.SC.480	0.5+weeding	9.87 b	9.45b
Met.SC.480	0.7	11.35a	10.65 a
Met.SC.480	0.7+weeding	10.32 b	9.78 b
Met.WP 70 %	300 g product	9.96 b	8.99 b
Met.WP 70 %	300 g product + weeding	9.87 b	8.50 b
Hand-weeding control	-	6.90 c	5.87 c
Cropped Weedy check	-	4.10 d	3.75d
L.S.D 5%			

Treatment means followed by the same letters, are not significantly different according to Duncan's Multiple Range Test .

Table (9) List Of Weeds In the Experimental Site :

FAMILY	SPECIES	ARABIC NAME
Amaranthaceae	**1)*Amaranthus graesizans***	Lisan Eltair Saghir
Solanacae	**2)*Datura stramonium .***	Saikaran
Solanacae	***3) Datura innoxia .***	Saikaran
Poaceae	***4) Echinochloa colona***	Lokh
Convolvulaceae	***5)Ipomoea cordofana .***	Tabar
Solanacae	***6) Solanum dubium .***	Gibain
Boraginaceae	***7) Echium rauwolfii .***	Kohali Shoka Gumri
Malvaceae	***8) Hibiscus trionum .***	
Asteraceae	***9) Xanthium brasilicum***	Ramtok
Asteraceae	***10) Sonchus oleraceus .***	
Asteraceae	***11) Sonchus cornutus .***	
Convolvulaceae	***12) Ipomoea sinensis .***	
Poaceae	***13)Sorghum***	Adar
Poaceae	***arundinaceum***	
Poaceae	***14)Dichantium annulatum***	Lukh
Poaceae	***15)Cynodon dactylon .***	Nageel
Poaceae	***16)Brachiaria eruciformis***	Um keriat
Fabaceae	***17) Rhynchosia mimnonia var memnonia***	Adan el Far
Euphorbiaceae	***18) Chrozophora plicata .***	Tarba
Cyperaceae	***19) Cyperus rotundrus .***	
Boraginaceae	***20) Heliotropium supinum***	Zanab el Agrab
Papaveraceae	***.21) Agremone mexicana .***	
Amaranthaceae	***22) Amaranthus viridis .***	Lisan Etiar kabir
Malvaceae	***23) Hibiscus lobatus*** .	Wakat Elkhala

CHAPTER FIVE

DISCUSSION

This study was conducted for two successive growing seasons at the Northern State to study the effect of two pre-emergence soil-applied herbicides , namely Metribuzin SC480 and Metribuzin 70% WP in controlling weeds in potato crop . Furthermore , the consequent effects of the two herbicides on some growth and yield parameter of potato crop were also studied .

From Table (1) it is evident that differences between some treatments concerning the plant height of potato plant in both two seasons were statistically significant . Metriuzin SC480 dose 0.7 kg a.i / F plus hand-weeding gave the maximum plant height then came Metribuzin SC480 dose 0.7 kg a.i / F without hand In both seasons , the hand-weeded control and the herbicide treatments at their different rates had significantly increased the plant height per-plant as compared to the un weeded check , similar results was obtained by Callihan *et al* (1976) who reported early application of Metribuzin to hand-weeded potatoes on silt loam result in taller plants, the result could be attributed to the use of the herbicides and the hand weeding which conspicuously suppressed weeds and freed potato plants to reach their potential length as more

nutrients , water , and space would be available to the crop .

In both seasons the two herbicides and the hand-weeded check significantly increased the number of leaves / plant as compared to the unweeded control. .This result confirmed the work of Evans (1968) who stated weed control with pre-emergence application of alachlor , linuron , metribuzin and stomp was good and no treatment caused a prolonged injury .This increase may be as a result of effective control of weeds by herbicides which might be furnish favorable environmental conditions . Also the high density of weeds in the weedy check plots as reflected by the number of weeds / m2 could prove the effect of weed / crop competition in reducing number of leaves / plant .

In both seasons , the hand-weeded control and the two herbicides at their different rates had significantly increased the number of branches / plant compared to the unweeded control . This increase can be due to the suppression of weed competition by the herbicides before the critical period of growth is reached . In fact the crop capacity to produce branches is greatly influenced by weed competition . Elimination of competition due to the removal of weeds by herbicides will maximize the chance that the crop use of the available resources which could be other wise been used by the weeds .

In both seasons the potato crop fresh weight / Plant was

significantly influenced by herbicides treatments and the hand-weeded control in comparison with untreated control . This result might be due to the fact that the dominant weeds in the experimental site such as *Amaranthus graesizans ,Datura stramonium ,Datura innoxia , Echinochloa colona ,Ipomoea cordofana ,Solanum dubium , Echium rauwolfii* were easily controlled by the herbicides used in this investigation. non of the mentioned weeds has had effect on shoot fresh weight /plant . Also this result could be explained in the light of the fact that the recorded number of weed flora in the weedy check plots were too many that result in retarded growth of potato plants which was reflected in low shoot fresh weight when compared with herbicides treated plots and hand weeded ones .

In both seasons Shoot oven-dry weight per plant was significantly increased by different rates of the herbicides and the hand-weeded treatments as compared to the control check . However , this result could be due to the fact that the recorded dominant weeds in the experimental site as mentioned before were easily controlled by the two herbicides used during this research work .

Since dry weight is the out come of branches stems and leaves / plant , so this significant increase in shoot oven-dry weight / plant may be due to an increased number of branches , stems and leaves as mentioned

before . All this reflect in the greater dry weight / plant as shown by obtained results . These result substantiated the conclusion of Misovic, 1972. concerning the increase of total dry matter of potato plants treated with Linuron . Khomenko, 1969 reported that Prometryne (a triazine herbicide) promoted potato growth at the beginning and middle of the growing season . He attributed this to the effect of the herbicide on plant metabolism and its tendancy to increase nutrients uptake .Here Meribuzin may possibly be have the same effect of promoting plant growth and consequently increase dry weight .

Weed biomass was significantly reduced with the two herbicides in both two seasons compared to the weedy check. Weed biomass reduction varied from 52.89 to 1.082 g / m2 valued as 94.88 % and from 45.51 to 1.46 g / m2 valued as 94.68 % in the first and second season , respectively . Similar findings were reported by Eberlein *et al*.(1997) who showed that the standard treatment of hilling plus a pre-emergence application of Metribuzin plus Pendimethalin in irrigated potato provided 99 % reduction in total weed biomass .

Both Herbicides at their different rates and the hand-weeded check resulted in a significant reduction in annual grass weeds population in both seasons . The best results (98.57 % - 97%)were achieved by the rate of 0.35 kg a.i / f of Metribuzin SC480 in both two seasons. Similar

results were achieved by M.O (1983) who stated that weed control with Metribuzin WP70 % was better than the other two herbicides Metobromuron and Linuron , combining herbicide (Metribuzin WP70 %) with hand-weeding further improved weed control.This may be attributed to the effectiveness of this herbicide.

The hand-weeding control and the two herbicides treatments had significantly reduced broad-leaved weeds population as indicated by percentage weed control in both seasons . However the high rate (0.7 kg a.i gave the best percentage control of annual broad-leaved weeds in both seasons (99.68% -99.28 %) .Similar results were found by M.O (1983) who reported that Metribuzin significantly gave lower weed population than the weedy controls ; (Linuron and metobromuron) .In addition to that similar results were recorded by Babiker (1979) who stated that supportive hand-weeding improved crop yields by improving weed control and helped to minimize shifts or changes in weed composition by controlling species which escape herbicidal effect. The above mentioned facts confirmed the good control of the herbicide Metribuzin to broad-leaved annual weeds .

The herbicides treatments and the hand-weeding check resulted in a significant total weed control percentage in both seasons . The low rates of Metribuzin SC480 used showed high percentage weed control range

from (94.88% - 94.68 %) in both seasons as compared to all other treatments .These results are in conformity with the finding of Lynn , and Edwards , (1980) who reported that application of Metribuzin at rate of 0.38 lb/h improved crop safety and broader spectrum of weed control .Also Dimitrijevic (1977) obtained best results in terms of weed control and yield with pre-emergence treatments using Sencor (Meribuzin WP 70%) at one kg , monolinuron and prometryne two liter plus stomp four liter products per hectare .

The different rates of herbicides used and the hand-weeded control had significantly increased the total yield of potato crop (ton / feddan) as compared by to the unweeded control in both two seasons . Almost all the treatments gave significantly high yield than the weedy check . The highest yield was obtained with Metribuzin SC480 dose 0.35 kg a.i / fed followed by Metribuzin SC480 dose 0.7 kg a.i / fed ,then came Metribuzin SC480 dose 0.5 , Metribuzin WP 70% dose 300g product / feddan respectively .The hand-weeding gave the lowest yield yet significantly higher than weedy check treatment's yield. Hand-weeding when applied to herbicide treated plot resulted in improved yield but significantly similar to the yield of un weeded herbicide treatments .

Countless evidence showed that it cannot be claimed that yield increase are general where use of herbicides has replaced post-planting

cultivation (Scragg , 1964). Similar results were indicated by M. Nour (1982) who reported that supplementary hand-weeding to Metribuzin WP 70 % treated potato plots gave consistently higher yield over all other treatments hand-weeded and / or control weedy .

CHAPTER SIX

SUMMERY AND CONCLUSION

This study was conducted at River Nile State (Northern Sudan) ; Hagar Elassal province 150 km . north Khartoum at Elbsabeer town among the fields of traditional, commercial potato producers . during the growing seasons 2000/2001 and 2001/2002 . The experiment aimed at evaluation of the efficacy of two pre-emergence soil-applied herbicides namely MetribuzinSC480 and Metribuzin WP 70% applied at the dose 0.7 kg a.i / F, 0.5 kg a.i / F and 0.35 kg a.i / F and Metribuzin WP 70% dose 300 g product / F on weed control , further it aimed at studing their effect on growth and yield of potato (*Solanum tuberosum.* L .) .

Major areas covered in this investigation include :

a) The effect of the two herbicides on five growth parameters of potato crop (plant height (cm) , number of leaves per plant , number of branches per-plant ,shoot fresh weight per plant (g) and shoot oven dry weight per plant (g) and final yield T / F) .
b) The effectiveness of the two herbicides on percentage weed control and weed biomass .

The following conclusions can be drown from the study :

1) Non of the herbicides used had any injurious or deleterious effect on the potato crop .
2) A significant increase in plant height (cm) in potato crop was achieved at all rates of the herbicides in both of two the seasons as compared to the unweeded control .
3) In both seasons the herbicides at their different rates resulted in an increased number of leaves per plant as compared to the control.
4) A significant increase was achieved in number of branches of potato plants due to the used herbicides and the hand-weeded control as compared to weedy control .
5) Fresh weight per plant had been significantly increased due to the use of herbicides and the hand-weeding in both of two the seasons as compared to the control weedy check .
6) Oven-dry weight per-plant had been significantly increased due to the use of herbicides and hand-weeding in both two seasons as
7) compared to the control weedy check .
8) Significant increase was achieved in final yield (T / F) of potato crop with application of the two herbicides at rates of 0.35 kg a.i / F , 0.7 kg a.i / F , 0.5 kg a.i / F) respectively for Meribuzin SC480 and 300 g product / F for Metribuzin WP 79% and the hand-weeding in both two seasons as compared to the control weedy check .

9) A consistent and a significant annual grass and broad-leaved weeds control was achieved with both herbicides at rates 0.35 kg a.i / F , 0.5 kg a.i / F and 0.7 kg a.i / F) for Meribuzin SC480 and 300 g product / F for Metribuzin WP 79% and the hand-weeding in both two seasons as compared to the control weedy check .

10) The dose 0.35 kg a.i / F proved to be more effective in controlling annual grasses and dose 0.7 kg a.i / F proved to be more effective in controlling broad-leaved weeds .

11) A persistent and a significant weed biomass reduction was obtained with the use of two herbicides in both seasons as compared to the weedy check. The greater reduction was achieved with the rates of Metribuzin SC480 especially dose 0.35 a.i/ f.

12) Some weed species in the experimental site such as *cyperus rotundus* and *cynodon dactylon* L.were partially controlled by the two herbicides .

Recommendations

The dose 0.35 kg a.i /fed of Metribuzin SC480 gave consistently higher yield overall other treatments .It improved weed control and yield ; so it could be recommended provided that its economical and less environmentally hazardous .

Mertribuzin SC480 herbicide is a rapidly degraded in the soil by microbial breakdown into a water soluble conjugates ; so it could be recommended that in areas of a very light and porous soil , with a shallow water table the herbicide should not be used repeatedly for many seasons .

Supplementary hand weeding to herbicide treated potato fields should be carried early in the second or third week after planting to avoid potato plant damage.

Further studies are recommended in identification of Metribuzin SC480 residues in soil and ground water if used in weed control programs in Sudan .

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List of Abbreviations

Kg a.i / Fed = Kilogram active ingredient per feddan .

L/ ha = Litre per hectare .

L/ F = Litre per feddan .

T/ ha = Tonne(s) per hectare .

T/F = Tonne(s) per feddan .

g = gram .

Cm = Centimeter .

C = Degree centigrade .

E.C = Emulsifiable concentrate .

i.e = That is to say .

MAA = Month after application .

WAA = Weeks after application .

C.V = Cultivar .

SE = Standard error .

SC = Soluble concentrate

PP = Pages .

LSD = Least Significant Difference .

WP = Wettable powder .

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