Opslagaartappels
Volunteer potatoes

2017

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Voorwoord

Die voordele van 'n goedbeplande gewasrotasieprogram kan ernstig in die gedrang kom as opslagaartappels nie goed beheer word nie. Aartappelknolle wat na die oes in die grond agtergelaat word, het 'n merkwaardige vermoë om in die grond te oorleef en op verkillende tye van 'n seisoen te spruit. Daarby is die winters in Suid-Afrika nie so koud dat die knolle in die grond doodvries nie. Effektiewe opslagbeheer is dus 'n uitdaging in aartappelproduksie, maar in besonder vir die moerkweker.

In hierdie publikasie word verskeie aspekte van opslagbeheer in diepte bespreek. Omdat beheer deur onkruiddoders op hierdie stadium die belangrikste maatreël is wat in die bedryf toegepas word, word die besprekings hoofsaaklik aan hierdie aspek gewy. Dr. James Allemann van die Universiteit van die Vrystaat het jare se ondervinding met die gebruik van onkruiddoders en word tans deur die aartappelbedryf befonds om effektiewe beheer van opslag deur onkruiddoders te ondersoek. Ek is oortuig daarvan dat die inligting in hierdie publikasie vir elke aartappelprodusent en landboukundige van groot waarde sal wees.

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Preface

The advantages of a well-planned rotation program can be seriously implicated if volunteer potatoes are not properly controlled. Potato tubers left behind in the soil after harvest, have the remarkable ability to survive in the soil and to sprout at different times during the season. In addition, the South African winters are not cold enough to kill-off tubers in the soil. Effective volunteer control is thus a challenge for potato producers and in particular to seed growers.

This publication discusses several aspects of volunteer control in depth. As control by herbicides is currently the most important way of control, most of the discussions are on herbicides. Dr James Allemann of the University of the Free State has vast experience in the use of herbicides and he currently receives funding from the potato industry to investigate effective control of volunteer potatoes using herbicides. I am confident that the information in this publication will be of great value to every potato producer and agriculturist.

Dr Fienie Niederwieser
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INHOUD • CONTENT

Hoekom is opslagbeheer so belangrik?

Dr. James en Anette Alleman, Universiteit van die Vrystaat

Die voorkoms van opslagaartappelplante en die probleem wat hierdie verskynsel veroorsaak is al meer as 80 jaar lank 'n kopseer in die landbougemeenskap en is die onderwerp van voortdurende navorsing wêreldwyd.

Gedurende die meganiese oes van aartappels bly groot hoeveelhede knolle op die land agter as gevolg van knolle wat nie opgetel word nie of deur die kettings val. Na beraming word soveel as 460 000 knolle op een hektaar agtergelaat nadat die knolle meganies gelig en die oes verwyder is. In Suid-Afrika beteken dit dat soveel as een ton knolle, die ekwivalent van 20 tot 25% van die massa

knolle wat oorspronklik per hektaar geplant is, na oes op die land agterbly. Hierdie knolle sal uitloop en gedurende die volgende seisoen begin groei. Dié opslag veroorsaak 'n ernstige onkruidprobleem in die daaropvolgende gewas.

Opslagplante is nie net 'n bron van kompetisie met die gewasplante vir water, voedingstowwe en lig nie, maar is ook die bron van skadelike organismes soos patogene, aalwurms en insekte. Een van die groot voordele wat 'n wisselboustelsel inhou is dat dit die lewenssiklus van peste en plae onderbreek deur gebruik te maak van plante wat nie gashere van hierdie probleem-organismes is nie. Die voorkoms van opslagplante hou die siekteketting in stand en beteken dus dat die voordelige uitwerking van die wisselboustelsel in die wiele gery word.

Opslagplante beïnvloed gewasproduksie soos volg: dit kompeteer met die daaropvolgende gewas, peste en plae kan oorgedra word na die volgende gewas en die opvolggewas in die wisselboustelsel kan gekontamineer word met plantreste van die opslagplant.

Kompetisie met die opvolggewas

Van die belangrikste faktore wat die welslae van 'n gewas bepaal is vrye toegang tot voedingstowwe, water, fisiese ruimte vir ontwikkeling (bo- en ondergronds) en sonlig. Wanneer 'n gewas geplant word, word die fisiese spasiëring van die plante op die land beplan om by die heersende toestande te pas om kompetisie tussen individuele plante te voorkom. Op hierdie manier word verseker dat elke plant gelyke toegang het tot die beskikbare voedingstowwe, water en lig. Dit verseker eweredige ontkieming, groei en opbrengs. Indien ander plante egter op die land voor en gedurende die groeiseisoen voorkom sal hulle met die gewasplante kompeteer vir hierdie noodsaaklike bronne (voedingstowwe, water en lig). Hierdie ander plante word nie op die land verlang nie en word dus as onkruide beskou – maak nie saak hoe nuttig hulle onder ander toestande is nie. Indien die onkruide (of opslagplante) net voor of op dieselfde tyd as die gewas opkom veroorsaak dit die grootste probleem, want die gewas is dan in direkte kompetisie met die onkruid wat opbrengste nadelig kan beïnvloed.

Wisselbouprogramme word hoofsaaklik geïmplementeer om die getalle van potensiële patogeniese organismes te verlaag deur gebruik te maak van nie-gasheerplante. Alhoewel hierdie praktyk wel die oordrag van aartappelsiektes kan verhoed, doen dit niks aan die probleem van opslagbeheer nie. Baie van die duisende knolle wat na die oesproses op die lande agterbly sal die volgende seisoen uitloop en opslagplante produseer wat met gewasplante sal kompeteer en lei to laer opbrengste. Hoe meer opslagplante, hoe groter sal die uitwerking op die verwagte opbrengste wees. In hierdie geval word opslagaartappels dus as 'n ernstige onkruid beskou.

Indien hierdie opslagplante nie beheer word nie kan dit lei tot geweldige verliese in opbrengs van die gewas wat geplant is. Die mate van verlies is direk eweredig aan die aantal plante wat op die land voorkom – hoe meer plante, hoe groter die verlies. Mielies word beskou as een van die plante wat die kompetisie-uitwerking van opslagaartappels die beste kan hanteer, maar selfs hier kan opbrengsverliese van tussen 23 en 62% voorkom indien opslagplante nie beheer word nie. In groentegewasse soos uie kan hierdie verlies tot so hoog as 92% wees. Nie net is die voorkoms van opslag belangrik nie, maar ook die tyd wat dit op die land teenwoordig is – hoe langer die kompetisie plaasvind, hoe groter is die opbrengsverlies.

Oordrag van peste en plae

Alhoewel plantmateriaal van die land verwyder of ingeploeg word om te verseker dat so min as moontlik gasheermateriaal op die land gelaat word om siekteveroorsakende organismes of vektore te huisves, moet in gedagte gehou word dat die aartappelknol 'n lewendige organisme is wat ook spore of eiers van peste en plae kan beskerm tot die volgende seisoen. Al is die betrokke siekte nie 'n probleem vir die opvolggewas nie, kan dit lei tot ernstige besmetting van die daaropvolgende aartappelaanplantings as gevolg van die lang tydperk wat opslagaartappels in die grond kan oorleef en reproduseer.

Peste en plae wat op opslagaartappels voorkom kan ook groot probleme tydens die berging van die volgende aartappeloes veroorsaak. 'n Goeie voorbeeld hiervan is die aartappelmot wat ernstige probleme gedurende opberging kan veroorsaak, al is dit nie tydens oes sigbaar nie. Die insek kan in die grond oorleef as eiers, larwes of papies op knolle wat in die grond agterbly. Die swam wat verantwoordelik is vir laatroes kan ook in baie ongunstige toestande in die grond in opslagknolle oorleef. Die organisme verantwoordelik vir bakteriese verwelksiekte van aartappels is veronderstel om geheel en al uitgewis te word wanneer die gasheerplant van die land verwyder word, maar enige knolle wat oorbly kan die oorsaak wees van oordrag van die siekte na gevoelige opvolggewasse.

Alhoewel die meeste opvolggewasse nie gevoelig is vir aartappelsiektes is nie, kan implemente wat in kontak was met geïnfekteerde plantmateriaal die siekte na ander lande versprei.

Die oorlewing van grondgedraagde siektes, wat grond vir redelike lang periodes kan kontamineer en dit ongeskik maak vir aartappelproduksie, is 'n baie belangrike rede

Figuur 1 – Bron van opslagaartappels

vir die beheer van opslagaartappels. Die voorkoms van opslagplante kan die oorlewingsperiode van hierdie siektes in die grond tot so 'n mate verleng dat dit die volgende aartappelgewas kan besmet. Siektes soos poeierskurf, bruinskurf en bakteriese verwelksiekte is uiters belangrik in hierdie verband.

Opslagplante kan ook die oorlewing van aalwurms bevoordeel. Uitskeidings van die wortels van opslagaartappelplante kan die ontkieming van eiers van aalwurms stimuleer, wat tot 'n toename in die bevolkings lei. Dit is dus krities belangrik dat opslagplante beheer word om getalle van aalwurms te verlaag.

Figuur 2 – omvang van die probleem

Opslagaartappelplante kan ook as gasheer optree vir insekte wat as vektore van viruse optree, veral plantluise. Dit is al gevind dat opslagaartappels wat met aartappelvirus X besmet is die voorkoms van die siekte met 12% teen die einde van die seisoen kan laat toeneem as dit nie beheer word nie. Enige opvolggewas wat gevoelig is vir hierdie virus sal ernstig benadeel word indien sulke opslagplante nie uitgewis word nie. Plantluise is ook 'n ernstige plaag op aartappels in Suid-Afrika en hulle kan 'n verskeidenheid virusse oordra na nie net opvolggewasse nie, maar ook ander aartappelaanplantings in die nabye omgewing.

Besmetting van opvolggewasse

Om verbruikers te beskerm en om 'n hoë graad van eenvormigheid te handhaaf is dit belangrik om 'n produk te kan lewer wat suiwer en vry van enige kontaminante is. Dit sluit gronddeeltjies sowel as vreemde sade en onkruidreste in. Kontaminasie kan probleme tydens verwerking en verpakking veroorsaak, en kan ook prys beïnvloed as gevolg van afgradering van die produk. Die blare en bessies van opslagaartappels kan veral probleme veroorsaak in groentegewasse, omdat bessies toksies is.

Moere moet gesertifiseer word en kontaminasie met knolle van opslagplante van 'n ander kultivar kan daartoe lei dat 'n gemengde variëteit geproduseer word. Alhoewel hierdie nie noodwendig 'n ernstige probleem in die produksie van tafelaartappels is nie, kan dit lei tot die afkeuring van die oes vir saaddoeleindes.

Hieruit kan gesien word dat die beheer van opslagaartappelplante van groot belang is om 'n klomp probleme met beide opvolggewasse en nabygeleë aartappelaanplantings te voorkom. Dit is ongelukkig baie moeilik om opslagaartappelplante te beheer en die volgende artikels in die reeks oor opslagaartappels sal kyk na die redes hiervoor, asook moontlike oplossings vir die probleem.

During mechanical harvesting large numbers of potato tubers, up to one ton per hectare, can remain behind on the land. These tubers sprout during the next season, and the resulting volunteer plants cause a serious weed problem. Not only do these volunteer plants compete with crops for nutrients, water and light, but they can also be the source of nematodes, insects and diseases. The greater the numbers of volunteer plants the greater the competition effect and the lower the yields obtained from the crop. Yield losses can be up to 62% in a competitive crop such as maize, or as high as 92% in sensitive crops. Crop rotation programmes generally aim to reduce pest and disease problems, but tubers that remain behind on the land can protect spores or eggs of pests and diseases until the following season, so negating the value of the rotation program. Diseases such as late blight and bacterial wilt, as well as viruses can survive on volunteer plants and be transmitted to nearby potato fields by insects or implements. Some of these diseases, as well as nematodes can survive on volunteer tubers and plants and affect the next planting of potatoes. If volunteers are not controlled before harvesting of the follow-up crop, serious contamination of the crop by leaf residue or the poisonous berries may lead to downgrading or rejection of the produce. Seed potatoes are certified, and volunteers can contribute genetic material of a different cultivar, leading to the product being rejected for use as seed. It can thus be seen that the control of volunteer potato plants is of great importance to prevent a number of problems in both follow-up crops and nearby potato crops.

Why are volunteer potatoes so difficult to control?

Dr James and Anette Allemann (University of the Free State)

Volunteer potato plants originate from true seed when berries occasionally develop and from tubers that are left in the field following the harvesting process. As much as one ton of tubers can remain behind on the land which is approximately 25% of the total amount of seed required to establish one hectare of potatoes.

Generally annual weeds are fairly easy to control using any of a number of methods such as cultivation or through the use of herbicides. However, being vegetatively propagated the volunteer potato plant is as difficult to control as a perennial weed. This group contains some of the most difficult weeds to control, and include weeds such as common

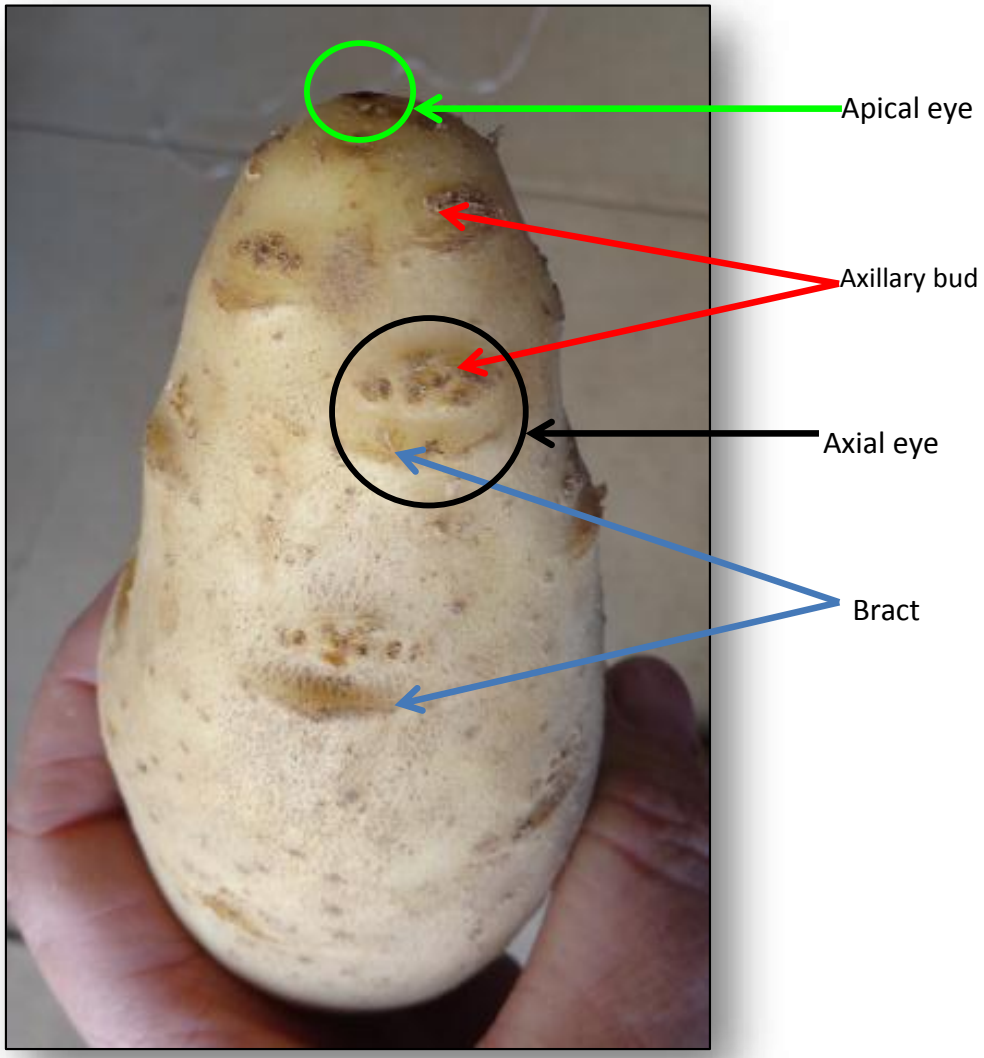


Figure 1 Parts of the potato tuber

couch grass (*Cynodon dactylon* or kweek) and nutgrass (*Cyperus spp.* - uintjies).

So what is it that makes perennial weeds so difficult to control? The major problem lies in their biology, which assists the weed to survive unfavourable conditions, and which in turn enables them to survive the application of both mechanical and chemical control.

Biology

The potato tuber is a modified stem (Figure 1). As such it contains nodes and internodes, and in the same way as any other stem has axillary buds in the leaf axils. Each "eye" that is found on a potato tuber consists of a leaf bract and an axillary bud. Each of these axillary buds can develop to form an independent potato plant. This means that each tuber is capable of producing a number of potato plants.

Sprouting and emergence of the volunteer plants depends on the soil temperature, the depth at which the tubers are buried and the amount of precipitation. As there is great variation in the depth at which tubers are found, emergence of plants from these tubers varies, and can take place over a period of two to three months.

Due to a phenomenon called apical dominance, the apical or end bud is the first one to develop and its development inhibits the emergence of axillary buds until the apical sprout has developed past a certain size. Once the apical sprout is self-supporting, the other buds on the tuber will sprout and start to develop into plants.

The initial growth of the young shoot depends on the supply of nutrients from the tuber. The plant now starts to produce its own food through photosynthesis and becomes independent of the tuber for its survival, a process that usually takes from 10 to 20 days. A seed tuber will normally

contain sufficient nutrients to support 30 days of growth without photosynthesis. Sprouts from smaller or deeply buried tubers will, therefore, have a reduced chance of emergence and/or survival.

The oldest and deepest stolons will form tubers first as they contain the highest levels of sucrose. This is where the largest tubers on the plant are formed. The smallest tubers will be found on the shallowest stolons. This variation in tuber growth is the cause of the variation in tuber size which is a characteristic of the potato, and also leads to the tubers that are too small to be harvested mechanically and remain behind in the field to produce volunteer plants the following year.

Effect of mechanical and chemical treatments

Volunteer plants that arise from true seed are easy to control, as they are effectively annual weeds and any control measure that kills the plant before it can form tubers, will result in total eradication. However, it is the plants that originate from tubers that cause the major volunteer problems that are being encountered.

Soil preparation tends to bury the tubers deeper into the soil profile and so protects them from unfavourable conditions. Research has indicated that sustained temperatures below -2.5°C will kill potato tubers, but such low temperatures are seldom encountered in South African production regions. As a result the tubers survive the winter and are ready to start growing and emerge during the summer months, just in time to create a weed problem in the crop following potatoes. Exposing the tubers on the soil surface would lead to the smaller tubers drying out and dying, but the larger tubers would still survive.

Those tubers that are found in the shallower soil layers will sprout and emerge first, followed by those from deeper soil levels. This results in sprouting and emergence taking place over an extended period of time, and this is where the problem with control arises. Using mechanical control will usually provide satisfactory control of the plants that emerge early in the season, but later emerging plants, or those that emerge within the crop row cannot be controlled mechanically. There is also the problem of apical dominance to contend with, as merely cutting off the apical shoot will not kill the plant, but merely result in the other buds on the buried tuber sprouting which can result in an increased problem.

This is also the problem with early post-emergence weed control, or even pre-emergence weed control, when the herbicide might well kill the apical shoot, but it does not prevent the other buds on the tuber from sprouting. The

Alhoewel die aartappel deur beide moere en knolle kan voortplant is dit hoofsaaklik die knolle wat oorsprong gee aan opslagplante wat 'n ernstige onkruidprobleem kan word. Dit word beraam dat tot soveel as een ton knolle per hektaar op die land kan agterbly na die meganiese oesproses, wat ongeveer 25% van die vestigingshoeveelheid is.

Die feit dat aartappels vegetatief voortplant plaas hulle in die moeilik beheerbare, meerjarige onkruidgroep saam met algemene onkruide soos kweek (*Cynodon dactylon*) en uintjies (*Cyperus spp*). Die aartappelknol is 'n aangepaste stingel met litte en knoppe, en by elke knop kom daar 'n skutblaar en okselknop (ogie) voor. Elkeen van hierdie okselknoppe (ogies) kan uitloop om 'n spruit (halm) te vorm en sodoende oorsprong gee aan 'n nuwe plant. Slegs 'n enkel plant sal vanaf die ware saadjie ontwikkel. Onder optimale toestande sal die apikale ogie eerste begin ontwikkel, en dit sal dan die ontwikkeling van ander ogies onderdruk tot die nuwe plant begin fotosintetiseer, waarna die ander ogies sal begin ontwikkel. Die grootste en vlakste knolle sal eerste uitloop, maar variasie in diepte en grootte van die knolle beteken dat die plant oor 'n periode van twee tot drie maande kan ontwikkel. Dit beteken ook dat opkoms deur die groeiperiode van die opvolggewas kan strek wat beheer uiters moeilik maak. Grondvoorbereiding kan knolle dieper in die grond begrawe wat dit teen ongunstige toestande beskerm, en wat weer daartoe lei dat groot hoeveelhede knolle onguns-tige toestande sal oorleef om tot opslagplante te kan ontwikkel. Indien slegs die apikale stingel gedood word sal die ander knoppe begin ontwikkel.

Tydsberekening van beheermaatreëls is dus krities. Uitstel van bestydingsmaatreëls om meer plante te laat opkom vir beheer kan daartoe lei dat die oudste plante al begin om knolle te vorm wat tot 'n volgende seisoen se probleme lei. Enige vooropkomsdoder wat gebruik word moet dus 'n redelike lang nawerkingsperiode in die grond hê om hierdie plante te kan bestry, en na-opkomsdoders moet op die regte groeistadium toegedien word om die beste beheer te gee. Dit kan dus gesien word dat opslagbeheer 'n moeilike saak is wat groot kopsere kan veroorsaak, baie soos die beheer van kweek en uintjies.

problem will merely return at a later stage as the other shoots emerge from the soil. It can thus be seen that any control measure to be successful against volunteer potatoes, will have to prevent sprouting of the other buds on the buried tuber in addition to killing the axial shoot. If this does not happen it will merely lead to an ever increasing problem as more shoots emerge from where there was only a single shoot.

The plants that develop from very small tubers or from those tubers that were deeply buried are fairly easy to control, as the tuber will have exhausted its nutrient supply by the time the first shoot emerges from the soil. This means that when these shoots are killed, there are not sufficient reserves remaining in the tuber to enable the later developing shoots to reach the soil surface, so these plants will die if subjected to mechanical control measures or suitable herbicides. However, these plants form a fairly small percentage of those that will develop during the season.

Added to these problems is the timing of any control measures to be used. If post-emergence control is delayed to try and time it so that the majority of plants have already emerged from the soil, one runs into added problems. Apart from the losses caused by competition with the crops' plants, the first plants to emerge will already have initiated tubers, and this will then lead to further volunteer potato problems during the following season. So, timing of control measure is crucial in order to try and limit the time during which volunteer potato plants will cause problems. Chemicals applied for pre-emergence control would need to have fairly long periods of residual activity in the soil to control later developing sprouts.

Control of volunteer potato plants can become a major headache for the producer, much in the same way as the control of nutgrass. Seed potato growers have a particularly difficult problem as any herbicide which inhibits sprouting in the next season, cannot be used. ©

Alernatiewe vir chemiese beheer van opslagaartappels

Dr. James en Anette Allemann (Universiteit van die Vrystaat)

Opslagplante kan verskeie probleme in die gewasproduksiestelsel veroorsaak. Hulle is sterk mededingende onkruide wat skadelike insekte kan huisves en ook 'n bron van siektes en aalwurms kan wees. Indien dié plante nie beheer word nie kan dit tussen die opvolggewas opkom en selfs uiteindelik oordra om die volgende aartappelaanplanting te besmet. Die bestuur van opslagplante is dus van uiterste belang, maar ongelukkig baie moeilik. Navorsing wêreldwyd het getoon dat slegs geïntegreerde bestuursmetodes sukses kan waarborg.

Die bestuur van opslagplante moet drie hoofdoelwitte

Volunteer plants can cause numerous problems in the production system, being extremely competitive weeds as well as a source of diseases. Management of these plants needs to reduce the competitive effect, prevent them from producing tubers as well as limit the number of host plants for pests and diseases. This article addresses the preventative, cultural and mechanical methods of control. Preventative management concentrates on limiting the number of tubers that can lead to volunteer plants. This can be achieved by proper management of the harvesting process in order to lift and remove the majority of tubers. However, even if this is perfect, the smaller and deeper tubers will remain behind. Use of a sprout inhibitor can prevent these tubers from sprouting the following year. Cultural management relies on the use of production techniques to either limit the occurrence of the problem, or to create an unfavourable environment for the survival of volunteer plants. The processes involved are crop rotation, inclusion of strongly competitive crops, or use of a fallow period to allow other methods of control to be used. These methods are usually combined with tillage and chemical treatment in an integrated management program. Mechanical management uses soil tillage operations to either remove the plants or destroy the tubers before they can become a problem. Repeated removal of sprouts by 3 – 4 shallow tillage operations, each carried out before the plants can initiate tubers, provides good control of volunteer plants. Better control will generally result when this is combined with chemical control. The control of volunteer potato plants is not an easy process, and no single method used in isolation will be entirely successful. The best results are obtained when all of these methods are combined with the use of suitable herbicides in an integrated management program.

probeer bereik:

a) Verminder kompetisie met die opvolggewas om opbrengsverliese te voorkom;
b) Voorkom die produksie van knolle deur opslagplante tussen die opvolggewas om verliese en beheer in die volgende gewas te verminder; en
c) Beperk die hoeveelheid oorlewende opslagplante wat as gasheer vir peste en plae kan dien vir die volgende aartappelaanplanting.

Om hierdie plante te beheer kan vier benaderings gevolg word – voorkoming, verbouing, meganies en chemies. Hierdie artikel sal slegs aandag aan die eerste drie benaderings skenk.

Voorkoming

Voorkomende bestuur konsentreer op die oorsaak van die probleem en het ten doel om die hoeveelheid knolle wat tot opslagplante kan ontwikkel te beperk. Tydens meganiese oes word klein knolle in die grond agtergelaat, en al word sigbare knolle met die hand opgetel, bly kleiner en dieper knolle agter. Onder alle omstandighede sal die voorkoming van knolle wat op die land agterbly die grootste deel van die opslagaartappelprobleem oplos. Voorkoming van knolle wat tot opslagplante lei is dus amper onmoontlik, maar dit bly nog een van die mees koste-effektiewe maatreëls vir die beheer van opslagaartappels.

Die hoogte van die plantwalle en stelling van die uithalerlem, gekombineer met die korrekte stroperkettingstellings en afvoer van geoeste knolle, speel 'n kritiese rol in die verwydering van die meerderheid knolle vanaf die land. Dit kan ongelukkig nog nie alle knolle verwyder nie, maar sal die opslagprobleem aansienlik verlaag. Tesame met plantwalle wat hoog genoeg is om te verseker dat alle knolle binne die wal ontwikkel, moet die uithaler se lem diep genoeg gestel word om die diepste knolle te lig sonder om hulle raak te sny, aangesien selfs klein stukkies knol wat 'n ogie bevat sal kan uitloop om 'n nuwe plant te vorm.

Die halms moet van die knolle verwyder word tydens oes, sodat dit nie deur die uithaler saamgesleep word nie en die waens moet direk onder die uitlaat van die uithaler wees om alle knolle op te vang. Onthou die grootste persentasie van boere gebruik steeds arbeid om die knolle fisies op te tel en in sakke te gooi. Uithalerstellings moet verhoed dat knolle by die ronding (bullnosing) kan uitpeul, en gapings tussen die skakels in die primêre ketting moet deurval van knolle verhoed, maar terselfdertyd die markbehoefte bevredig. Die korrekte verhouding tussen

die spoed van die uithaler en die spoed van die ketting sal grondverwydering en knolbeweging optimaliseer.

Vervroegde veroudering van die halms kan beïnvloed word deur grondvrugbaarheid en grondvog, asook siektes en peste wat kan lei tot meer klein knolle wat agterbly. Oor die algemeen dra plante wat tydens oes groen is, groter en meer knolle as plante wat reeds dood is. Die grootste persentasie van hierdie knolle word ook binne 10 cm onder die grondoppervlakte gedra. Ons beveel aan dat die gewas behoorlik afsterf voor oes sodat die skil behoorlik kan set om meganiese beskadiging te verminder.

Die gebruik van spruitinhibeerders soos maleïenhidrasied onderdruk die aantal opslagplante in die opvolggewas. Die gebruik hiervan tydens moerproduksie is nie 'n opsie nie, maar is wel 'n moontlikheid vir die produsente van tafel- of verwerkingsaartappels.

Verbouingspraktyke

Verbouingsbestuur steun op die gebruik van verbouingspraktyke om òf die voorkoms van die probleem te verminder, òf om 'n ongunstige omgewing vir die oorlewing van opslagplante te skep, bv. die insluit van sterk kompeterende gewasse, of die insluiting van gewasse in die wisselboustelsel wat die gebruik van geskikte onkruiddoders sal toelaat saam met gesonde akkerboukundige-praktyke.

Wisselbou onderdruk die grondbelading van siektes en insekte deurdat die opvolggewas nie vatbaar is vir siektes en peste van die vorige gewas nie, en dus nie as gasheer kan dien nie. Vorige gewasse se reste word gewoonlik verwyder of begrawe vir ontbinding, maar in die geval van aartappels bly die vrugbare knolle, 'n moontlike gasheer vir siektes en peste, agter. Grane is oor die algemeen nie baie vatbaar vir kompetisie of aartappelsiektes nie, maar groente soos uie en wortels word baie vinnig oorgroei. Wisselbou moet egter saam met bewerkingspraktyke in 'n geïntegreerde onkruidbeheerprogram gebruik word. In die noordelike halfrond kan ploeg gedurende winter en vroeë lente knolle na die oppervlak bring en dit aan lae temperature blootstel wat hulle dood.

Ongelukkig is die wintertemperature in Suid-Afrika oor die algemeen nie laag genoeg (<-1.5 °C) vir lank genoeg om opgeploegde knolle te dood nie, so ook is die injaag van diere om dié knolle te vreet ook nie sonder probleme nie. Die insluiting van 'n braakperiode, indien moontlik, kan ook die bestuur van opslagplante aansienlik vergemaklik aangesien beheermaatreëls dan baie makliker toegepas kan word sonder die gevaar van gewasbeskadiging Vir die beste werking teen opslagaartappels behoort wisselbou saam met bewerking en chemiese behandeling in 'n geïntegreerde beheerprogram toegepas te word.

Meganies

Meganiese bestuur behels die gebruik van grondbewerking om òf die opslagplante te verwyder, òf die knolle van opslagplante te vernietig voor dit 'n groot probleem kan veroorsaak, byvoorbeeld die insluiting van 'n vlakbewerking na oes. Herhaaldelike meganiese verwydering van spruite oor 'n lang tydperk kan 'n negatiewe invloed hê op die verskyning van opslagaartappels, maar 'n enkele vroeëseisoenbehandeling kan die produksie van klein knolle verhoog en die behandeling sal slegs effektief wees as deel van 'n geïntegreerde beheerprogram.

Spruite kan van so diep soos 20 cm onder die grondoppervlakte uitgroei en die uithaler moet dus tot op hierdie diepte kan oes. Selfs met goed ontwerpte uithalers en die korrekte bewerkingsmetodes, sal die heel kleinste knolle nog agterbly, maar daar sal heelwat minder wees. Die gebruik van drie- tot viervlakbewerkings wanneer die aartappelplante op die 9 – 11 blaarstadium is, beheer opslagplante baie goed. Hierdie stadium is dalk bietjie laat aangesien plante dan reeds knolle geïnisieer het, en dit sal waarskynlik beter wees om hierdie bewerkings toe te pas sodra plante die 4 – 6 blaarstadium bereik, net voor knolinisiasie plaasvind. Oor die algemeen is gevind dat meganiese beheer baie meer effektief is wanneer dit saam met chemiese beheer toegepas word om opslagplante te beheer.

Slot

Dit is duidelik dat die beheer van opslagaartappelplante nie 'n maklike taak is nie weens die verskeidenheid van faktore wat 'n rol daarin speel, byvoorbeeld die biologie van die knol en tyd van knolinisiasie op die plante. Daar is wel moontlikhede vir die beheer van opslagaartappelplante sonder om chemiese middels te gebruik, maar die gebruik van hierdie metodes afsonderlik van mekaar verlaag die kanse vir sukses. Suksesvolle beheer van hierdie lastige onkruide noodsaak 'n kombinasie van al hierdie metodes. Die beste resultate word egter behaal wanneer al hierdie metodes saam met geskikte onkruiddoders ingespan word in 'n geïntegreerde bestuursprogram.

Possibilities for the chemical control of volunteer potatoes

Dr James and Anette Allemann (University of the Free State)

Volunteer plants are a major problem as they are extremely aggressive weeds that compete with crop plants for water, nutrients and light. This can lead to a reduction in yield that is directly proportional to the numbers of volunteer plants found on the land – the greater the numbers, the greater the yield reduction. Even in maize, a plant considered to be the best in dealing with competition from volunteer potatoes, yield losses can amount to between 23 and 62%.

The longer volunteer plants are on the land, the worse

the competition effect, and the larger the yield reduction. Control of these plants is critical within the first 2 to 6 weeks after planting, as this is the period when most crops are extremely sensitive to weed competition. Also, if not controlled in time, these volunteer plants will initiate tubers that will continue the problem for a number of years following the potato crop. This can lead to the total failure of the crop rotation system to control potato pests and diseases prior to planting the next potato crop.

The previous article in this series discussed the use of non-chemical methods to control volunteer potato plants, whilst this article will address the possibilities of chemical control. There are a number of possibilities in this regard, such as the use of sprout inhibitors, soil fumigants and herbicides, both pre- and post-emergence.

Sprout inhibitors

These products are usually applied to prevent tubers from sprouting during storage, but can also be applied to plants at the end of the growing season to prevent the formation of the small undesirable tubers that are often the source of volunteer plants. Sprout inhibitors should only be used by table producers and never applied close enough to seed potato plantings so that spray drift could contaminate the seed potato fields.

A number of products are available to suppress tuber sprouting such as chlorpropham and maleic hydrazide. Chlorpropham is registered in South Africa (Act 36 of 1947) for use as a sprout inhibitor during storage, even though it also has herbicidal activity against potatoes in the field. Malic hydrazide is possibly the best known sprout inhibitor and is used successfully in commercial potato plantings throughout the world. In South Africa, however, it is only registered for the prevention of sprouting in stored onions.

In order to prevent sprouting of volunteer tubers the product needs to be applied as a full cover spray as it is absorbed by the foliage and translocated to the tubers where it remains and prevents the buds from sprouting, so preventing development during the following season. If applied early after tuber initiation it not only prevents sprouting, but also tuber growth. The product has been shown to reduce the numbers of volunteer plants by 70 to 80% if used correctly, but the results depend on the cultivar used as well as the size of the tubers. Although sprouting and shoot emergence from all size tubers are suppressed, the effect is unfortunately the lowest in the smaller tubers, i.e. those that cause the greatest problem.

Soil fumigation

This involves the use of a volatile chemical, mainly to suppress nematodes and other soil pathogens. However, certain of these products have been shown to markedly

Figure 1 Effect of the soil fumigant metham potassium at a rate of 1 035 kg ai ha-1 on the emergence of potato plants

Figure 2 An example of the variation in control of potatoes, from total death of plants, through severe growth inhibition to growth suppression by a pre-emergence herbicide

reduce tuber viability and suppress the growth of volunteer potato plants. It is difficult to obtain uniform applications of these fumigants, and together with uneven distribution through the soil, caused by soil type and conditions coupled with the use of sub-lethal applications rates, can result in poor performance and variable results.

Some well-known soil fumigants are ethyl dibromide (EDB), metam sodium (MS) and metam potassium (MP), all of which are registered for use on seedbeds in South Africa. EDB is more effective when applied during cooler winter months, but requires specialised application techniques, while MS and MP can be applied through an irrigation system. At high enough dosages more than 90% suppression of volunteer plants can be obtained using MS and MP (Figure 1). An added advantage of using soil fumigants is that they also reduce the numbers of annual weeds by more than 90%, and are effective on both dormant as well as non-dormant tubers.

Although very effective, fumigants are fairly costly, thereby making them viable only on small areas or preceding high value crops. However, factors such as soil moisture and temperature during application as well as proper placement and dispersal of the product, have an effect on the dosage of the fumigant required, and this is an aspect requiring further research.

Herbicides

Herbicides are manufactured and used to deal with specific types of weeds in specific cropping situations. Products can be either selective, controlling certain plants without damaging others, or non-selective, killing all plants. Application times for the products also vary, being classified as pre-plant, pre-emergence or post-emergence depending on the timing of application during the cropping cycle. Herbicides can also be classified as systemic or contact products, with the former being absorbed by plants

and killing them over time, while the latter usually kill foliage on contact.

Ongoing research shows that volunteer potato plants are very difficult to eradicate using herbicides, with most products tested proving to be either ineffective or only partially effective (Figure 2). The greatest problem is caused by the biology of the potato tuber as large food reserves available in the parent tuber, coupled with a number of adventitious buds that can sprout after the death of the apical sprout, enable recovery from damage that would be lethal to most other weeds.

The problem is further compounded by the variation in the time of emergence of volunteer potato plants, which makes application timing of many post-emergence (foliage applied or contact) products very difficult in order to obtain good control. Most contact herbicides do nothing more than kill the shoots that have emerged from the soil at the time of application, and the tuber is able to produce new sprouts which then emerge long after the primary plants have been killed. If these shoots are not treated, it will result in the production of tubers that will create further problems the following season. The only way to prevent tuber production is through complete shoot removal prior to the shoots initiating tubers.

Thus far the use of single conventional herbicides has proven to be unsuccessful in the control of volunteer potatoes. Due to the devastating effect these plants have on succeeding crops, various regimes of herbicide combinations have been researched with variable results.

Conclusion

The chemical control of volunteer potato plants is very difficult due to the numerous factors which play a role, including climatic and soil factors, the biology of the tuber and time of tuber initiation. The use of various chemicals in isolation from other methods of control reduces the chances of successful control of these troublesome weeds. The best results in volunteer potato control are normally obtained when all methods of control are combined in an integrated management program.

The next article in the series will discuss the use of pre-emergence herbicides for the control of volunteer potato plants.

Moontlikhede van chemiese beheer van opslagaartappels

Hierdie artikel bespreek verskillende chemiese metodes (spruitinhibeerders, grondberoking en onkruiddoders) wat aangewend kan word om opslagplante te beheer.

- Alhoewel spruitinhibeerders soos malïenhidrasied die voorkoms van opslag-plante tot 80% kan verlaag wanneer dit reg aangewend word, kan dit nie in die omgewing van moerlande gebruik word nie. Ongelukkig is die effek van hierdie middels op klein knolle die grootste bron van opslagplante, beperk.
- Grondberokingsmiddels soos metam natrium kan knol-kiemkragtigheid merkwaardig verlaag en ook die groei van opslagplante onderdruk. Dit kan die getalle van beide opslagaartappel-plante en eenjarige onkruid met tot 90% verlaag indien dit reg en teen hoog genoeg toedieningshoeveelhede aangewend word. Hierdie behandelings is egter duur, en die resultate kan deur verskeie faktore soos grondvog, temperatuur en kultivar beïnvloed word.
- Die biologie van die aartappelknol veroorsaak beheerprobleme deur onkruiddoders, want hierdie plante kan skade oorleef wat die meeste ander onkruide sal dood. Die variasie ten tye van verskyning van opslagplante maak tydsberekening van na-opkoms onkruiddodertoediening moeilik, en enige oorblywende plante kan knolle produseer wat tot toekomstige probleme kan lei.
- Enkel-onkruiddoders is tot nou sonder sukses aangewend in die beheer van opslagaartappelplante, en kombinasies van onkruiddoders het wisselvallige resultate gelewer.
- Dit is dus duidelik dat chemiese beheer van opslagplante moeilik is as gevolg van die talryke faktore wat 'n rol speel.
- Die gebruik van verskeie chemikalieë in isolasie verlaag die kanse op suksesvolle beheer.
- Die beste resultate in opslagbeheer word verkry wanneer alle beheermetodes gekombineer word in 'n geïntegreerde bestuursprogram vir opslagplante.

Gebruik van vooropkoms-onkruiddoders vir die beheer van opslagaartappels

Dr. James en Anette Allemann (Universiteit van die Vrystaat)

Onkruiddoders word vervaardig en toegedien om spesifieke onkruide binne bepaalde gewasverbouingsomstandighede te beheer.

Onkruiddoders kan geklassifiseer word op grond van:

- **Selektiwiteit**. Selektiewe middels beheer sekere

plantspesies (die onkruide) sonder om ander (die gewas) te beskadig, terwyl nie-selektiewe middels alle plante dood.

- **Tyd van toediening**. Onkruiddoders kan voor plant toegedien word (gewoonlik produkte wat ingewerk moet word), vooropkoms (na plant maar voor die gewas of onkruide opkom), of na-opkoms (nadat gewas en/of onkruide opgekom het).

- **Werking**. Afhangend van die tipe gebruik kan onkruiddoders as sistemiese- of kontakdoders geklassifiseer word. Sistemiese produkte word deur die plante opgeneem en vervoer na die plek in die plant waar hulle aktief is, en dood plante oor tyd. Grondtoegediende sistemiese doders het ook 'n bepaalde nawerkingsperiode, d.w.s. die periode wat hulle in die grond aktief sal bly en plante sal dood. Nie sistemiese- of kontakdoders is gewoonlik baie giftig en sal die loof van plante dood kort na die doder daarop gespuit is. Hierdie doders het gewoonlik geen of 'n geringe nawerkingseffek in die grond.

Vooropkomsdoders

Vooropkomsdoders is selektiewe, sistemiese doders wat beteken dat hulle op 'n spesifieke gewas toegedien kan word om bepaalde onkruide te dood sonder om die gewas te beskadig. Dit moet egter in gedagte gehou word dat gewasskade wel onder sekere omgewingstoestande kan voorkom, al is die doder op die gewas geregistreer. Dit is dus baie belangrik dat produkte streng volgens die riglyne wat op die etiket voorkom toegedien word. 'n Uiters belangrike punt om te onthou met die gebruik van enige onkruiddoder, is dat die produkte wat op gewasse gebruik word wel in terme van Wet 36 van 1947, soos gewysig, geregistreer moet wees. Indien nie, kan gewasskade voorkom, al was die onkruiddoder in die buiteland of in die verlede plaaslik sonder probleme gebruik. Met sistemiese doders wat 'n nawerkingsperiode van etlike jare het, soos byvoorbeeld pikloram, kan skade nog steeds 'n paar jaar na gebruik voorkom.

Die biologie van die aartappelplant beïnvloed die effektiwiteit van vooropkomsdoders

Navorsing oor die beheer van opslagaartappels is oor baie jare in die buiteland uitgevoer. Daar is bewys dat opslagplante besonder moeilik met vooropkomsdoders uitgewis word. Die grootste probleem word veroorsaak deur die biologie van die aartappelknol wat groot voedselreserwes in die moederknol bevat, en gekoppel met die groot aantal adventiewe knoppe wat na die dood van die apikale spruit kan uitloop, veroorsaak dit dat die plante van skade kan herstel wat die meeste ander onkruide sal dood. 'n Belangrike doelwit met die gebruik van onkruiddoders is nie net om die opslagplante te dood nie, maar ook om te verhoed dat hulle knolle produseer of, indien daar wel knolle geproduseer word, hierdie knolle nie lewensvaatbaar sal wees nie.

Vooropkomsdoders word aan die grond toegedien en sal knolle wat in die grond voorkom vir 'n langer periode aan die onkruiddoder blootstel. As gevolg van die nawerkingseffek is die onkruiddoders ook geredelik beskikbaar vir opname deur die wortels en/of spruite van die ontwikkelende aartappelplant vir etlike weke of maande. Dit maak die keuse van hierdie tipe doders baie aantreklik vir die beheer van opslagaartappelplante. In hierdie artikel sal gebruik gemaak word van chemiese name eerder as handelsname, maar Tabel 1 gee beide die handelsname en gewasse waarop hierdie doders in Suid-Afrika geregistreer is. 'n Latere artikel sal kyk na die Suid-Afrikaanse situasie betreffende onkruiddoders wat vir opslagbeheer gebruik/geregistreer is.

Resultate uit die buiteland

Oor die jare is etlike onkruiddoders met grondaktiwiteit teen opslagaartappels getoets. Vroeëre werk het aangedui dat chloropropham, propisamied, trifluralien, pikloram, dichlobenil en ethofumesate belowende resultate vir

Figuur 1: Klomazoon-skade aan Mondial-aartappelplante in potproewe 35 dae na behandeling. Let op die nuwe groei wat op herstel toon.

beheer van opslag het. Uiteraard kan hierdie doders op verskillende gewasse gebruik.

- **Chloorprofam** is nie net 'n onkruiddoder nie, maar ook 'n spruitinhibeerder, en dit is juis vir hierdie doel in Suid-Afrika geregistreer. Alhoewel hierdie onkruiddoder wel aanvaarbare beheer getoon het, het veldproewe gewys dat dit nie voldoende aktiwiteit gegee het om opslagaartappels met 'n enkel toediening te beheer nie. Latere werk het getoon dat twee of drie toedienings 'n paar dae uitmekaar nodig sou wees om voldoende beheer te gee. Veldproewe het egter getoon dat toedienings van soveel as 12 kg/ha uitloop slegs effens inhibeer sonder om die opbrengs en aantal knolle wat geproduseer is noemenswaardig te verlaag. Dit beteken dat opslagaartappels die volgende jaar weer 'n probleem sal wees.
- **Trifluralien** en **propisamied** het goeie aktiwiteit teen opslagaartappels getoon, maar in veldproewe is vasgestel dat baie hoë toedienspeile nodig sou wees vir aanvaarbare beheer. Hierdie toedieningspeile was so hoog dat dit die meeste opvolggewasse sou beskadig.
- **Pikloram** en **dichlobenil** toedienings aan die grond voorkom dat aartappelknolle uitloop, en beide doders het in die meeste gevalle die moederknol ook gedood. Beide doders het egter baie lang nawerkingsperiodes in die grond en die algemene siening is dat, nieteenstaande die uitstekende beheer van opslagaartappels, hulle gebruik nie prakties sal wees nie.
- Oorspronklike werk het aangedui dat **ethofumesate** teen 1 – 2 kg/ha goeie aanvanklike inhibering van beide uitloop- en spruitontwikkeling gegee, maar die plante het met tyd herstel. Die uiteindelike effek van die behandeling het baie min uitwerking op opbrengs en kiemkragtigheid van knolle gehad. Latere werk het aangedui dat vooropkomstoediening van hierdie doder opkoms van aartappelplante vertraag het en opslagplante in 'n reeks gewasse onderdruk het, terwyl die tipe behandeling knolgetalle met tot 45% verlaag het.
- Toedienings van **Atrasien** en **Sianasien** teen 0.6 en 1.1 kg/ha het vergeling en dood van opkomende spruite van opslagplante veroorsaak. Toedienings van atrasien teen 1.1 kg/ha het ook tot 'n 90% vermindering in die produksie van nuwe knolle op opslagplante veroorsaak. Ongelukkig het atrasien die nadeel dat dit wel onder sekere omgewingstoestande na die volgende seisoen kan oordra, wat weer die gewaskeuse kan beperk aangesien dit 'n sterk breëblaardoder is.
- **Klomasoon** teen 5.6 kg/ha het 100% beheer van opslagplante 20 dae na behandeling gegee, maar dit het afgeneem met tyd tot slegs 78% na 34 dae (Figuur 1). Hier kan gesien word hoe die biologie van knolle, diepte van knolle, en nawerking van die onkruiddoder teen die mens werk wat latere beheer betref. Ongelukkig is hierdie resultate ook verkry met 'n voorplantbehandeling waar die onkruiddoder in die grond ingewerk is.
- Een van die nuwe doders wat deesdae beskikbaar is, is **mesotrioon** wat of voor- of na-opkoms toegedien kan word. Die meeste werk met hierdie doder op opslagaartappels is met na-opkomstoedienings gedoen, maar dit is wel gerapporteer dat 'n vooropkoms-toediening van 0.21 kg/ha tot vergeelde en wit spruite gelei het, alhoewel daar hier en daar spruite sonder skade ontwikkel het (Figuur 2).

Uit hierdie bespreking van die buitelandse resultate is dit duidelik dat die beheer van opslagaartappelplante met vooropkoms-onkruiddoders baie moeilik is. Daar moet egter in gedagte gehou word dat omgewingstoestande (klimaat en grond) in die meeste gevalle heeltemal verskillend is van wat ons hier in Suid-Afrika het en wat soms daartoe lei dat ons toedieningspeile van onkruiddoders heelwat verskil van wat in die buiteland gebruik word. Die tweede punt wat in gedagte gehou moet word is dat ons in die meeste gevalle ander kultivars plant as wat in die oorsese proewe gebruik is. Verskillende kultivars reageer verskillend ten opsigte van onkruiddoders. Alles is egter nie verlore nie en ongeag die feit dat daar nie belowende resultate in die buiteland gekry is nie, beteken dit nie dat daar nie geskikte onkruiddoders vir Suid-Afrikaanse gebruik sal wees nie. ©

Figuur 2: Mesotrioon-skade aan Sifra aartappelplante in potproewe 35 dae na behandeling.

Tabel 1: Vooropkomsdoders in die teks genoem wat in Suid-Afrika geregistreer is

Chemiese naam / Chemical name	**Handelsnaam /** Trade name	**Akkergewas/se Field Crop/s**
Atrasien / Atrazine	Agrizine SC Atraflo 500 SC Atranex 500 SC Atrasien 500 SC Atrazine SC Atrazine 500 SC Ciplazine 500 Atranex 90 WG Atrazol Gesaprim 90 WG	Kanola / Canola Graansorghum / Grain sorhum Mielies / Maize Pynappels / Pineapples Suikerriet / Sugarcane
Chloorprofam / Chlorpropham	Neostop	Geen (Spruitinhibeerder) / None (sprout inhibitor)
Klomasoon / Clomazone	Command 4 EC Kalif 480 EC	Sojabone / Soybean Tabak / Tobacco
Sianasien / Cyanazine	Avi-Bladex 500 Avi-Fortrol SC	Ertjies / Peas Katoen / Cotton Suikermielies / Sweetcorn Suikerriet / Sugarcane
Mesotrioon / Mesotrione	Astron 480 SC Callisto Cantron SC	Mielies / Maize
Pikloram / Picloram	Access 240SL Browser	Geen (Slegs vir beheer van bome en struike in landerye wat nie onder verbouing is nie) None (Only for control of trees and shrubs on land that is not under cultivation)
Propisamied / Propyzamide	Kerb 500 WP	Kanola / Canola Blaarslaai / Lettuce
Trifluralien / Trifluralin	Crew Herbicide Makhrotref 480 EC Rifle Trifluralin Trifluralin EC Trifluralin 480 EC Triflurex 480 EC	Gars / Barley Kanola / Canola Koring / Wheat Kool / Cabbage Geelwortels / Carrots Rissies / Chillies Katoen / Cotton Akkerbone / Cowpeas Droeëbone / Dry beans Grondbone / Groundnuts Sonneblom / Sunflower Tamaties / Tomato Sojabone / Soybean

Use of post emergence herbicides

Dr James and Anette Allemann (University of the Free State)

The major advantage of using a post-emergence (POST) herbicide application is that the extent of the weed problem is already evident, which makes treatment of specific problem areas in the field possible. Overseas research indicates that the best application time for POST herbicides is during the tuber initiation process. However, volunteer plants emerging from the soil over an extended period, make a single POST application for control of these plants impossible.

Unlike pre-harvest (PRE) herbicides POST herbicides cannot be classified into a single group. The herbicides used for POST control can be divided into the following three groups:

- Contact herbicides – these are highly toxic products that kill plant tissue on contact, such as paraquat.
- Non-selective herbicides – these herbicides will kill all plants that they come in contact with, for example glyphosate.

- Selective herbicides – these products will kill certain plants, for example weeds, while not damaging others, like the crop.

It is always important to remember that products should be applied strictly according to the guidelines given on the label, which gives the recommended application rates, the crops on which the product can be used, as well as the weeds which are normally controlled. POST herbicides are applied to the foliage of the plants, and as such the soil type does not affect the working of the herbicide. For more information see the article on the PRE herbicides on pp. 20 to 23. It must be remembered that these herbicides do not usually have any period of residual activity as very little herbicide comes into contact with the soil.

Results from overseas

A number of POST herbicides have been tested for their ability to control volunteer potatoes over the years, but the effects have proved disappointing, with the majority of products only being capable of suppressing the growth of volunteers rather than providing complete control. (TABLE 1).

- Triclopyr injured potato plants in the field at rates of >100 g ha-^{1}, and prevented production of viable tubers when used at rates of 1 kg ha-^{1}.
- Paraquat and diquat are both contact herbicides and only kill that portion of the plant that is above the soil surface. Plants re-sprouted soon after treatment, and tuber yields were only slightly reduced. A similar effect could be obtained through regular pulling of emerged sprouts.
- Amitrole applied later in the season provided effective control, but can only be used when no crop is present due to the period of residual activity in the soil. It is as effective as glyphosate in controlling volunteers.
- Carfentrazone-ethyl is primarily a contact herbicide, and is used the same way as paraquat. However, three applications at 7 – 10 day intervals starting when plants are 7 – 11 cm tall resulted in >80% control and reduced tuber mass by >76%.
- Mesotrione applied at a rate of 0.11 kg ha-^{1} when the potato plants were between 100 and 150 mm tall has been shown to control the top growth of potatoes by approximately 97% and reduce tuber formation by between 96 and 99%. Broadleaf crops are sensitive to this herbicide so a waiting period prior to planting sensitive crops is required, which can adversely affect rotation systems.
- Tembotrione is in the same family as mesotrione, but is not as effective in the control of volunteers as mesotrione, giving only 80 – 90% control.
- Topremezone gave results similar to those of tembotrione when applied at a rate of 5 g ha-^{1}.
- Fluroxypyr gave slightly more than 80% control of volunteers when applied at the eight leaf stage, but required a tillage operation ten days after application in order to reduce tuber numbers. This is the only herbicide that is currently registered in South Africa to control volunteer potatoes. It causes scorching and distortion of foliage and reduces the capacity of the plants to produce viable tubers in the year following application (Figure 1).
- Clopyralid causes distortion of the stems and foliage of the plants, as well as reducing the numbers, mass and viability of daughter tubers, so reducing the threat of volunteer plants in the year following treatment.
- Oxyflurfen will suppress potato growth, but requires multiple applications and needs to be combined with tillage operations in order to keep volunteers under control.
- Flumioxazin provides variable results, suppressing volunteer plants as a POST application, but is more successful when used as a PRE application at 35 – 70 g ha-^{1}.
- Ethofumesate has been shown to suppress potato growth and reduce the competitive effect of potato plants. Although control is achieved shortly after application, better results can be obtained by combining PRE- and POST applications of this herbicide.
- Prometryn causes necrotic lesions and stunted growth following a single application, but the most effective treatments proved to be sequential sprays of 1.2 kg ha-^{1}, or a single application of 2.23 kg ha-^{1}. The latter treatment could be as successful as hand weeding, and also reduced mass and number of tubers produced by the volunteer plants.

Figure 1 Fluroxypyr phytotoxicity on Sifra potato plants 7 days after application in pot trials.

- Glyphosate provided excellent control of potatoes when applied at rates of more than 1 kg ha-[1] when applied after the sprouts had fully emerged. Although the plants still produce large numbers of small tubers research demonstrated that no sprouts, or severely deformed sprouts, developed on the tubers of treated plants. Results are, unfortunately, variable (Figure 2), and is affected by both the age of the plants at the time of treatment, as well as the application rate used. This herbicide will not, however, control sprouts that have not yet emerged when the land is treated.
- Imazamox is also effective in killing potato plants and reducing the mass of daughter tubers in the USA.

Repeated applications of contact herbicides are also effective in controlling volunteer potatoes. However, care should be taken not to spray these herbicides onto the crop plants as these may also be damaged.

Conclusion

From this overview of overseas results it can be seen that controlling volunteer potato plants using POST emergence herbicides is not an easy task. It should be kept in mind, however, that the cultivars used in South Africa, as well as the conditions under which the herbicides are applied, differ appreciably from those countries in which these results were generated. As different cultivars react differently to herbicides it may be that a product that is only partially successful in controlling plants of one cultivar can provide 100% control of another. The fact that volunteer plants emerge from the soil over an extended period of time, so making single application of POST herbicides difficult, has resulted in a decision to concentrate the search for a suitable herbicide for volunteer control in South Africa to products that can be used prior to emergence of the crop. ©

Figure 2 Glyphosate damage to Mondial potato plants 10 days after application in pot trials.

Gebruik van na-opkoms onkruidoders vir opslagaartappelbeheer

'n Groot voordeel met die gebruik van na-opkoms-doders is dat die omvang van die onkruidprobleem reeds sigbaar is en behandelings van slegs gedeeltes van die land moontlik is. Ongelukkig is 'n enkeltoediening nie moontlik nie weens die lang periode waartydens opslagplante opkom. Ons kan na-opkomsdoders in drie groepe indeel:

- Kontakdoders wat plante op aanraking dood.
- Nie-selektiewe doders wat alle plante dood waarmee hulle in kontak kom.
- Selektiewe doders wat slegs onkruide en nie die gewas sal dood nie.

Dit is baie belangrik dat alle voorskrifte op die etiket streng gevolg word om te verseker dat daar geen probleme ondervind word nie. Navorsing in die buiteland het oor die algemeen teleurstellende resultate opgelewer, alhoewel daar ook belowende produkte is. Oor die algemeen is gevind dat meer as een bespuiting benodig word om die beste resultate te verkry, maar daar is wel 'n paar uitsonderings.

Mesotrioon het baie goeie resultate gelewer teen 'n peil van 0.11 kg ha-[1], so ook fluroksipir en glifosaat. Die toedieningstyd, -hoeveelheid en opvolgbehandelings speel 'n groot rol in die sukses van na-opkomsbeheer van opslagaartappelplante.

Kontakdoders soos dikwat en parakwat brand net die bo-groei dood en verhoed nie verdere groei van plante nie. Daar moet gesorg word dat hierdie doders nie in kontak kom met die gewasplant nie om skade te voorkom.

Dit is dus duidelik dat die beheer van opslag-aartappelplante met na-opkomsdoders nie maklik is nie, en oor die algemeen word herhaalde bespuitings, of die insluiting van 'n meganiese bewerking benodig.

Daar moet in gedagte gehou word dat kultivars verskil in hulle verdraagsaamheid teenoor onkruiddoders, wat beteken dat 'n doder wat min effek op een kultivar het, plante van 'n ander kultivar totaal kan uitroei.

Die feit dat opslagplante oor 'n lang periode opkom het daartoe gelei dat ons meer op die gebruik van vooropkomsmiddels gaan konsentreer in die soektog na 'n geskikte onkruiddoder vir opslagbeheer in Suid-Afrika.

Slegs Fluroksipir is in Suid-Afrika geregistreer vir die beheer van opslagaartappels

Chemical name / Chemiesenaam	Trade name / Handelsnaam	Field crops / Akkerbougewasse
Amitrole / Amitrool	Weedazol	Grapes / Wingerd
Carfentrazone-ethyl / Karfentrasoon-etiel	Aurora 40WG	Barley / Gars, Wheat / Koring
Clopyralid / Klopiralied	Lontrel 100 SL	Canola / Kanola
Diquat / Dikwat	Aqua-Quat, Midstream	Contact herbicide / Kontakdoder
Flumioxazin / Flumioksasin	Sumimax WP	Groundnuts / Grondbone, Soya beans / Sojabone
Fluoroxypyr / Fluroksipir	Starane 200EC, Tomahawk 200EC, Voloxypyr 200EC	Maize / Mielies, Pastures / Weidings, Wheat / Koring
Glyphosate / Glifosaat *	Glygran SG, Mamba DMA 480SL, Mamba Max 480SL, Touchdown Forte HiTech, Panga Plus 540SL, Roundup Power Max, Slash Plus 540SL	Cotton / Katoen, Maize / Mielies, Soya beans / Sojabone
Imazamox / Imazamoks	Cysure, Imazamaxx	Canola / Kanola, Lucerne / Lusern, Leguminous pastures / Peulplantweidings, Clovers / Klawers, Medics / Medics
Mesotrione / Mesotrioon	Astron 480 SC, Callisto, Cantron SC	Maize / Mielies
Nicosulfuron / Nikosulfuron	Sanson 4 SC, Nic-It, Accent, Nicogran 750 WG, Nicomax 75 WG, Nicoron 750 WDG, Nicosulfuron 750 WDG, Nicosulfuron 750 WG	Maize / Mielies
Oxyflurfen / Oksifluorfen	Fenox, Galigan 240 EC, Goal 2XL 240 EC Orion 240 EC, Oxyfluorfen 240, Victory 240 EC, Goal 480 SC	Broccoli / Brokkoli, Brussels sprouts / Brusselse spruite, Cabbage / Kool, Cauliflower / Blomkool, Garlic / Knoffel, Onions / Uie, Sugarcane / Suikeriet
Paraquat / Parakwat	Skoffel SL, Agroquat, AVI Parakwat, Ciplaquat 200, Gramoxone, Nexus, Araquat SL, Paragone SL' Paraquat, Paraquat 200, Shinquat 200 SL, Skoffel Super	Contact herbicide / Kontakdoder
Prometryn / Prometrien	Gesaguard	Carrots / Geelwortels, Cotton / Katoen, Peas / Ertjies
Topremezone / Topremesoon	Campus	Maize / Mielies
Triclopyr / Triklopir	Garlon 480 EC	Sugarcane / Suikerriet

* - Only on glyphosate resistant crops or directed applications / Slegs op glifosaatbestandegewasse of gerigte bespuitings
Contact herbicides can only be used as directed applications / Kontakdoders kan slegs as gerigte bespuitings gebruik word.

Gebruik van onkruiddoder-mengsels vir die beheer van opslagaartappels

Artikel: Dr. James en Anette Allemann, Universiteit van die Vrystaat

Uit die vorige besprekings oor die gebruik van enkel onkruiddoders saam met die biologie van die aartappelplant, is dit duidelik dat die antwoord vir beheer moontlik lê in die gebruik van 'n kombinasie van verskillende onkruiddoders. Daar is verskeie moontlikhede:

- Toediening van 'n vooropkoms-onkruiddoder, gevolg deur die gebruik van 'n na-opkoms-onkruiddoder om spruite wat later opkom te beheer;
- Gebruik van meer as een na-opkomstoediening met verskillende onkruiddoders; en
- Toediening van 'n mengsel van onkruiddoders met verskillende wyses van werking.

In laasgenoemde geval is dit baie belangrik dat die etiketaanwysings rakende die meng van produkte streng gevolg word. Indien dit nie gedoen word nie, kan dit lei tot swak onkruidbeheer en/of gewasskade. Produkte kan chemies onverenigbaar wees, wat tot 'n chemiese reaksie tussen die twee middels lei, of die produkte saam kan lei tot 'n sinergistiese of antagonistiese reaksie. In die

eerste geval kan dit maklik in die spuittenk waargeneem word want 'n jel vorm sodra die twee produkte gemeng word. Sinergistiese en antagonistiese reaksies kan slegs na toediening gesien word. In die eerste geval is die mengsel meer effektief as enige van die aparte doders in die mengsel, en dit kan tot gewasskade lei, terwyl in die tweede geval die mengsel veel swakker beheer gee as wat met enige van die doders in die mengsel apart verwag sou word.

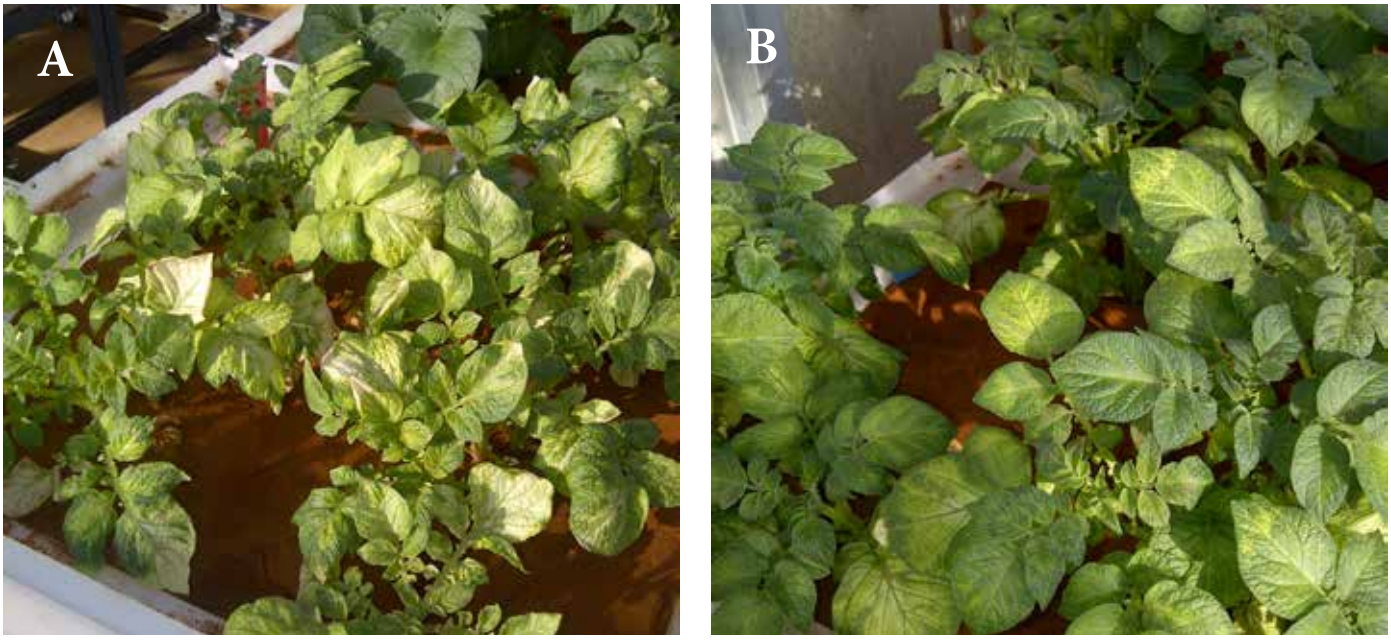
Buitelandse resultate

Die grootste probleem met hierdie tipe benaderings is om die regte toedieningspeile van die produkte te probeer bepaal. Die peile van vooropkomsdoders word deur die gewas en klei-inhoud van die grond bepaal, terwyl die maksimum toedieningspeil van na-opkomsdoders hoofsaaklik deur die tipe onkruid bepaal word. Daar moet in gedagte gehou word dat die maksimum toedieningspeil van vooropkomsdoders nie die maksimum aanbevole peil soos aangedui op die etiket vir die betrokke gewas mag oorskry nie. Die gebruik van sekere doders kan ook die keuse van opvolggewasse beperk.

Effektiewe beheer van plante en 'n 95% afname in knolmassa is verkry deur die toediening van atrasien (1.1 kg ha^{-1}) voor opkoms, gevolg deur 'n na-opkomstoediening van 'n mengsel van dikamba (0.28 kg ha^{-1}) en 2,4-D (1.1 kg ha^{-1}). 'n Kombinasie van 'n vooropkoms- en 'n na-opkomstoediening van fluroksipir (0.22 kg ha^{-1}) het ook baie goeie beheer van opslagaartappels gegee. Die gebruik van atrasien kan egter die keuse van opvolggewasse beperk want onder sekere klimaat- en grondtoestande kan die nawerking daarvan tot in die volgende seisoen duur.

In uie is gevind dat die gebruik van bromoksinil (0.2 kg ha^{-1}) gevolg deur oksiflufen (0.17 kg ha^{-1}) bolmassa en –getalle verlaag met tussen 69 - 96% en 32 – 86% respektiewelik wanneer dit met 'n grondbewerking net na die toediening van elke doder gekombineer word. Die gebruik van twee bespuitings van Fluroksipir teen 0.3 kg ha^{-1} verlaag die bolmassa van opslagplante met meer as 90% indien 'n grondbewerking die toedienings volg. Die gebruik van 'n vooropkomstoediening van ethofumesaat (0.6 kg ha^{-1}), gevolg deur twee na-opkomstoedienings van 'n mengsel van ethofumesaat bromoksinil (0.3 kg ha^{-1} en 0.2 kg ha^{-1}) het die massa en getal knolle wat deur opslagplante geproduseer is, verlaag. Die uitwerking van hierdie behandeling was veel beter indien grondbewerking toegepas is na die na-opkoms onkruiddoderbespuitings.

Uitstekende beheer van opslagaartappels is verkry wanneer 'n vooropkomsbespuiting van ethofumesaat (3.4 kg ha^{-1}), gevolg is deur 'n vroeë na-opkomsbespuiting (2.2 kg ha^{-1}) sodra plante 7 – 11 cm hoog is. Een van die chemiese maatskappye beveel 'n tenkmengsel van klopiralied en ethofumesaat aan as een van die beste behandelings teen opslagaartappels, terwyl 'n navorser in die VSA beweer dat 'n enkel toediening van 'n mengsel van carfentrazone-etiel (9 g ha^{-1}) en dikamba (280 g ha^{-1}) sodra plante 15 – 18 cm hoog is, van die beste behandelings teen opslagaartappels is.



Klomasoonsimptome op (a) Mondial en (b) Sifra aartappelplante in 'n potproef.

Mesotrioonsimptome op (a) Mondial en (b) Sifra aartappelplante in 'n potproef.

Navorsers in die staat Washington (VSA) het bepaal dat onder toestande aldaar slegs die volgende twee onkruiddodermengsels beter as 90% beheer van opslagplante gegee het: Primsulfuron (0.03 kg ha^{-1}) en dikamba (0.07 kg ha^{-1}), asook Fluroksipir (0.24 kg ha^{-1}) en MCPA (0.56 kg ha^{-1}).

Onderdrukking van opslagplante kan verkry word deur fluroksipir (0.78 kg ha^{-1}) en atrasien (1.12 kg ha^{-1}), terwyl die byvoeging van atrasien teen peile van 0.56 of 1.12 kg ha^{-1} tot mesotrioon, tembotrioon, topramasoon, en 'n mengsel van diflufenzopir en dikamba beheer tot 96% verbeter het. In graangewasse het die toevoeging van tribenuron-metiel (18 g ha^{-1}) tot fluroksipir (0.576 kg ha^{-1}) in 'n tenkmengsel goeie beheer gegee.

Daar word beweer dat die byvoeging van atrasien tot mesotrioon beheer van opslagaartappels sal verbeter, terwyl die gebruik van bromoksinil (0.28 kg ha^{-1}) of bentasoon (0.56 kg ha^{-1}) saam met mesotrioon gelei het tot 14 – 17% swakker beheer. Navorsing het egter getoon dat variërende resultate oor jare verkry word met die mengsels, terwyl die beheer wat deur mesotrioon gegee word konstant gebly het.

In alle gevalle is gevind dat die doeltreffendheid van onkruiddoderbehandeling verbeter kan word deur dit met 'n grondbewerking te kombineer.

Uit die voorafgaande bespreking van buitelandse navorsingsresultate kan gesien word dat die beheer van opslagaartappelplante deur gebruik te maak van onkruiddodermengsels nie maklik is nie, en die insluiting van grondbewerking beheer in alle gevalle verbeter. Die resultate dui ook aan hoe belangrik omgewingstoestande is in die bepaling van die effektiwiteit van onkruiddodertoedienings. Kultivarverskille ten opsigte van gevoeligheid teen verskillende onkruiddoders kom ook voor. Die kultivars wat in Suid-Afrika verbou word, en die klimaatsomstandighede waaronder ons aartappels produseer verskil aansienlik van dié van die lande waar hierdie proewe uitgevoer is. Hierdie resultate kan dus nie net so in Suid-Afrika toegepas word nie. Aangesien verskillende kultivars verskillende gevoelighede vir onkruiddoders toon, is dit moontlik dat 'n doder wat 100% beheer van die plante van een kultivar gee, slegs gedeeltelike beheer gee wanneer dit op plante van 'n ander kultivar gebruik word. Die ander faktor wat in gedagte gehou moet word wanneer hierdie resultate in oënskou geneem word is dat die onkruiddoders in verskillende formulasies en die konsentrasie van aktiewe bestanddele in die formulasies heelwat kan verskil tussen wat in die buiteland en plaaslik voorkom. Dit is die rede hoekom die doderkonsentrasies in kg of g aktiewe bestanddeel per hektaar aangedui word. Dit is ook moontlik dat die hoeveelhede wat gebruik word die maksimum aanbevole toedieningshoeveelheid in Suid-Afrika kan oorskry weens grondverskille.

Use of herbicide mixtures to control volunteer potatoes

As the use of pre-emergence and post emergence applications are problematic, the answer to volunteer potato control possibly lies in the use of herbicide mixtures. There are different possibilities:

- A pre-emergence herbicide, followed by the use of a post-emergence herbicide to control later developing shoots;
- The use of more than one post emergence application with different herbicides; or
- Application of a mixture of herbicides with different modes of action.

It is extremely important that all label directions regarding acceptable mixtures are followed as any deviation could lead to problems due to chemical incompatibilities, or synergistic and antagonistic effects. The best results are generally obtained using a pre-emergence application followed by one or more post-emergence applications of herbicides. The herbicides to be used depend very much on the crop that is being cultivated, but in all cases it was found that incorporating a tillage operation following the post-emergence herbicide application improved results. The herbicide mixtures recommended for the best control of volunteer potatoes differed appreciably between crops and localities where the trials took place. It was clear that environmental conditions played an important role in the determination of the efficacy of the various herbicide treatments, with the exception of pre-emergence mesotrione applications. It must be borne in mind that cultivars differ appreciably in their sensitivity to various herbicides, and that a herbicide, or herbicide mixture, that gives 100% control of the plants of one cultivar could have very little effect on the plants of another cultivar. It is also almost impossible to be able to use the results of overseas research in South Africa, as the cultivars used locally, as well as the environmental conditions under which the herbicides are applied, differ appreciably.

Chemiese naam / Chemical name	Handelsnaam / Trade name	Akkergewas/se / Field crop/s
Atrasien / Atrazine	Agrizine SC	Kanola / Canola
	Atraflo 500 SC	Graansorghum / Grain sorhum
	Atranex 500 SC	Mielies / Maize
	Atrasien 500 SC	Pynappels / Pineapples
	Atrazine SC	Suikerriet / Sugarcane
	Atrazine 500 SC	Graansorghum / Grain sorhum
	Ciplazine 500	Mielies / Maize
	Atranex 90 WG	Pynappels / Pineapples
	Atrazol	Suikerriet / Sugarcane
	Gesaprim 90 WG	
Bendioksied (Bentasoon) / Bendioxide (Bentazon)	Basagran	Aartappels / Potatoes
	Bendioxide 480 SL	Droëbone / Dry beans
	Bentazone 480 SL	Ertjies / Peas
	Bentamax	Gars / Barley
	Hornet 480 SL	Graan sorghum / Grain sorghum
		Groenbone / Green beans
		Grondbone / Groundnuts
		Hawer / Oats
		Koring / Wheat
		Mielies / Maize
		Rog / Rye
		Sojabone / Soya beans
Bromoxynil / Bromoksinil	Brominex EC	Gars / Barley
	Bromotril	Graansorghum / Grain sorghum
	Bromoxynil 225 EC	Hawer / Oats
	Bromoxynil 225	Koring / Wheat
	Campatop 225 EC	Lusern / Lucerne
	Voloxynil B225 EC	Mielies / Maize
	Bromotril 400 EC	Peulplantweidings / Leguminous pastures
	Bentrol Super	
	Brominal Super	
	Buctril-DS	
	Pardner Super	
	Bromotril P 500 SC	
Karfentrasoon-etiel / Carfentrazone-ethyl	Aurora 40WG	Gars / Barley
Klopiralied / Clopyralid	Lontrel 100 SL	Kanola / Canola

Chemiese naam / Chemical name	Handelsnaam / Trade name	Akkergewas/se / Field crop/s
2,4-D / 2,4-D	2,4-D Demethylamine Salt	Aartappels / Potatoes
	2,3-D Amine 480 SL	Gars / Barley
	2,4-D Amine SL	Graansorghum / Grain sorghum
	2,4-D Amine	Koring / Wheat
	2,4-D Amine 480	Mielies / Maize
	2,4-D	Rog / Rye
	Amino SL	Suikerriet / Sugarcane
	Avi-Amine 7,2 SL	Weidings / Pastures
	2,4-D Ester 500 EC	
	2,4-D Ester EC	
	2,4-D Ester	
	2,4-D Iso-octyl Ester	
	Wildebees Ester	
Dikamba / Dicamba	Banvel 480 SL	Graansorghum / Grain sorhum
	Dominator	Mielies / Maize
		Koring / Wheat
Fluroksipir / Fluoroxypyr	Starane 200EC	Mielies / Maize
	Tomahawk 200EC	Weidings / Pastures
	Voloxypyr 200EC	Koring / Wheat
MCPA / MCPA	Avi-D-Weed	Aartappels / Potatoes
	Makhro MCPA	Gars / Barley
	MCPA 400 SL	Graansorghum / Grain sorghum
	MCPA	Koring / Wheat
	MCPA 700 WSG	Mielies / Maize
	Missile	Rog / Rye
		Suikerriet / Sugarcane
		Weidings / Pastures
Mesotrioon / Mesotrione	Astron 480 SC	Mielies / Maize
	Callisto	
	Cantron SC	
Oksifluorfen / Oxyfluorfen	Fenox	Brokkoli / Broccoli
	Galigan 240 EC	Brusselspruite / Brussel sprouts
	Goal 2XL 240 EC	Kool / Cabbage
	Orion 240 EC	Blomkool / Cauliflower
	Oxyfluorfen 240	Knoffel / Garlic
	Victory 240 EC	Uie / Onions
	Goal 480 SC	Suikerriet / Sugarcane
Topremesoon / Topremezone	Campus	Mielies / Maize
Tribenuron-metiel / Tribenuron-methyl	Granstar	Gars / Barley
	Vulcan	Koring / Wheat

The current situation regarding chemical control of volunteer potatoes in South Africa

Dr James and Anette Allemann (University of the Free State)

Producers all over the world have been dealing with the problem of volunteer potatoes as weeds in other crops within the rotation system for a long time, and a great deal of research has been carried out in Europe and America in the search for a simple chemical control method. Unfortunately, volunteer potato plants are extremely difficult to eradicate using herbicides, and most products are at best only partially effective, or even entirely ineffective in controlling these plants, as has been seen in the previous articles in this series. Although there are herbicides available that can deal with these plants very effectively, their use can create problems. In many cases they can restrict the options for future crops on the land due to long periods of residual activity, or they could pollute groundwater. In the former case this can limit the crops which can be incorporated in the rotation program, and in

the latter cause problems with the use of the groundwater for the irrigation of sensitive crops.

From a legal point of view it is important to realise that products can only be used according to Act 36 of 1947 (Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act). This restricts the use of products to certain crops and roles as defined on the product label, and uses outside of these restrictions allows the user no legal recourse in the event of problems being caused by the product.

Current South African situation

Very little research has apparently been conducted into this problem in South Africa, as no published data could be found. Most producers utilise mechanical control, or resort to unregistered herbicides in an attempt to control volunteer plants. Post-emergence applications of picloram (Access or Browser) have been used with success by many farmers as this product is very effective in dealing with volunteer potato plants. However, this herbicide has a very long period of residual activity in the soil and is not registered for use on any agronomic crops. This herbicide has been linked to later problems with damage to sensitive crops on soils where it has been used.

The only herbicide currently registered for the control of volunteer potatoes in terms of Act 36 of 1947 is fluroxypyr. This product is known under the trade names Starane 200 EC, Tomahawk 200 EC and Voloxypyr 200 EC. All three products are registered for the control of volunteer potatoes in maize and wheat, but Starane is also registered for the control of these plants in Eragrostis pastures. The product is applied as a post emergence spray once most of the potatoes have emerged, and can be applied at increasing application rates (0.75 – 1.25 L ha^{-1}), until they are in the flowering stage. Plants should be thoroughly wetted by the herbicide spray, and only plants that have already emerged at the time of herbicide application will be controlled (Figure 1).

Local research

The problems caused by volunteer plants are common to all potato producers. They are particularly acute for the seed potato growers, where the occurrence of volunteer plants can negate the effects of a well-planned crop rotation system in suppressing nematodes, diseases and insect pests. This can lead to problems with pests moving from volunteer plants to planted fields and result in seed certification problems. Recognising the seriousness of the problem Potatoes South Africa, in collaboration with the University of the Free State, commenced with a multi-year research project into the identification of suitable systemic herbicides that could be used to control volunteer potato plants.

Figure 1 Fluroxypyr phytotoxicity on Sifra potato plants 7 days after application in pot trials.

Figure 2 Phytotoxicity caused by mesotrione on Mondial and Sifra plants 43 days after planting in pot trials.

Although there is a fair volume of research on this problem available overseas, there are a number of factors that preclude this data merely being taken and applied as is in South Africa. The factors that are particularly important in this regard are primarily related to climatic and soil differences, as well as differences in the cultivars used, but there are also some problems that are related to the herbicides themselves. One of the major advantages that most American and European producers have is that the winter temperatures drop below freezing for a number of weeks during the winter months, and this helps in the control of tubers from which volunteer plants can develop. Unfortunately, this is not the case in the majority of South African production regions, and this leads to larger problems. When using post emergence products in particular the climate can play a very important role, as they affect the way in which the plants grow, absorb and transport the herbicide, and ultimately how the plants react to the herbicide application. It can therefore be seen that the climatic differences between where the herbicides were tested and here, can play a major role in the determination of the activity of the products

Soil factors such as clay and organic matter content play an extremely important role when looking at the pre-emergence products that are applied to the soil surface. Generally South African soils have less than 1% organic matter content, while those encountered in Europe and America have far higher amounts of organic matter. This influences the application rates of the herbicides, and ultimately how well they work. The application rates can be higher than those usually used in crops in South Africa, and using the higher rates here, can lead to crop damage.

The genetic make-up of a plant also determines how susceptible or tolerant that species are to any given herbicide. This means that a herbicide that can control plants of one potato cultivar extremely well, might have no effect on another. Consequently herbicides that are shown to kill plants of Pentland Dell (the most commonly used cultivar for testing in the US), might have absolutely no effect on Mondial plants, the most common cultivar planted in South Africa.

The active ingredients and formulations of herbicides used to control volunteers overseas are not always the same as those that are available in South Africa, and this can lead to some problems regarding the use of the products. Products that have been used with success overseas are not always available in South Africa.

The testing program in South Africa started by looking at the herbicides with which success had be achieved overseas, both pre- and post-emergence products. The list was then further refined by excluding the products that were not available in South Africa. As the most common crop following potatoes is maize, a list was made of all the products that are registered for use on maize, and the various application rates at which the products may be applied.

Post-emergence products are difficult to use given that volunteer plants emerge from the soil over a fairly long period of time, so the timing of the correct application time is very difficult. This means that more than one application will be required in order to control all of the plants that come up in a land. Consequently, it was decided to stop looking at these products and concentrate on those that could be used prior to planting (pre-plant) the new crop, or before it emerged from the soil (pre-emergence).

The major advantage of using a post-emergence (POST) herbicide application is that the extent of the weed problem is already evident, which makes treatment of specific problem areas in the field possible. Overseas research indicated that the best application time for POST herbicides is during the tuber initiation process. However, volunteer plants emerge from the soil over an extended period, making a single POST application for control of these plants impossible.

Controlling volunteer potato plants using a single herbicide application is almost impossible, particularly as a number of different cultivars are produced, and the plants emerge from the soil over an extended period. As different cultivars react differently to herbicides it may be that a product that is only partially successful in controlling plants of one cultivar can provide 100% control of another. A suitable product will also need to have a fairly long period of residual activity in the soil to be able to control plants for an extended period of time. From a weed perspective it is not necessary to provide control over the entire season as late emerging plants will not have a large impact on yields. However, from the crop rotation perspective it is preferable to stop any emergence of volunteer plants that may serve as a source of pests and diseases, or allow pests and diseases to survive. This is what makes the search for a suitable product so difficult.

Promising results have been obtained in pot trials with mesotrione (Figure 2), a product registered for both pre- and post-emergence application in maize, at the rates registered for use in maize crops, as well as with metam potassium, a soil fumigant. Both of these products will be undergoing evaluation in field trials under different soil and climatic conditions over the next few seasons.

Huidige situasie met betrekking tot chemiese beheer van opslagaartappels in Suid-Afrika

Wêreldwyd is gevind dat dit baie moeilik is om opslagaartappelplante met onkruiddoders te beheer, en dat die meeste produkte óf oneffektief is, óf slegs deels effektief is teen hierdie plante. Opslagaartappels is veral belangrik vir moerkwekers want dit kan die waarde van 'n goed beplande wisselbouprogram vir die beheer van aalwurms, asook siekte- en insekplae vernietig en tot sertifiseringsprobleme lei. Die meeste produsente in Suid-Afrika maak gebruik van óf meganiese beheer, óf spuit soms 'n ongeregistreerde produk soos pikloram, wat tot ander probleme kan lei, en hulle onbeskermd laat vir enige eis teen gewasskade. Pikloram het 'n baie lang nawerkingsperiode in die grond wat tot probleme met gevoelige opvolggewasse kan lei, en kan ook maklik deur die grond beweeg wat tot besoedelingsprobleme in grondwater kan lei.

Slegs fluroksipir is in Suid-Afrika geregistreer vir die na-opkomsbeheer van opslagaartappels in mielies en koring. Aangesien opslagplante oor 'n lang periode in die landerye kan verskyn, is dit baie moeilik om hulle met so 'n na-opkomsmiddel te beheer. Die klem van navorsing is dus verskuif na voorplant- en vooropkomsmiddels. Die ideale doder moet op plante van die meeste kultivars werk, redelik lank aktief bly om die opkoms van laatspruitende knolle te beheer, maar ook geen skade aan gevoelige opvolggewasse veroorsaak nie. As gevolg van klimaat-, grond- en formulasieverskille, asook verskille in kultivars wat gebruik word, is dit nie moontlik om buitelandse inligting in Suid-Afrika te gebruik nie. Die soektog vir 'n geskikte produk word bemoeilik deur die vereistes van totale dood van opslagaartappels om die waarde van die wisselboustelsel te bewaar. Uit 'n onkruidperspektief sal plante wat laat opkom opbrengs min beïnvloed, maar vernietig die waarde van die wisselboustelstelsel. Dit is dus nodig om 100% beheer te kry wat die soektog na 'n geskikte middel bemoeilik.

Belowende resultate is met mesotrioon, asook met die grondberokingsmiddel metam kalium in potproewe verkry. Hierdie twee produkte sal nou in die veld getoets word.

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