

Weed Science

Conference Lecture: Weeds and weed problems in Sudan: Current challenges and future prospective

E S Mohamed, Mubarak H A, D A Dawoud, N E Ibrahim, K A M Bedery, N K Abdalla, K I Idris, M E Elkhawad, E A Ahmed, A S Osman, A A El Awad

Weeds are generally defined as plants growing where are unwanted. They lead to direct yield losses through competition, parasitism and allelopathy. Weeds compete with the crop for water, nutrients, light and space. Weeds differ in the damage that they cause to crops and this is governed by their growth habit, vigour, seed production, regenerative capacities and time of germination. Since the beginnings of agriculture, growers have had to compete with agricultural pests for crop products grown for human use and consumption. The total global potential loss due to pests varied from about 50% in wheat to more than 80% in cotton production. Of the total annual loss in agriculture produce, weeds account for 45%, insect 30%, disease 20% and other pests 5%. Weed control is an important part of crop production. In general, agronomic practices that produce a healthy, fast-growing crop will provide the best competition against weeds. Hand pulling, hand hoeing, manual weeding, cultivation, rotation and other effective cultural practices have been used for weed control in different crops. The introduction of herbicides has dramatically changed production in many crops. The development of 2,4-D and MCPA revolutionized weed control in cereals. Since World War II, a great number of herbicidal ingredients have been marketed. Herbicides increasingly replaced the labour-intensive mechanical weed control and enabled machine harvesting of crops.

Ploughing and discing prior to crop sowing and repeated hand weeding operations carried out by casual labour have been used for weed control in different crops in Sudan. In the past labour for hand weeding was abundant, wages were low and cost of weeding constituted small proportion of the total cost of production. In recent years, however, labour was unable to cope with intensive weed growth during the early stage of crop growth and unable to carry out the optimum number of weedings and this lead to serious crop losses. Moreover, scarcity of labour, expansion of crop area, diversification and intensification and continuous movement of younger generation to urban area and abroad have led to considerable rise in the cost of hand weeding and serious weed problems. Different methods of weed control in Sudan in field and horticultural crops are practiced. Cultural, mechanical and chemical methods are the main methods for weed control in Sudan. The parasitic weeds, *Striga*, *Orobanche*, *Cuscuta* are widely spreading in Sudan parasitizing economically crops including cereals, legumes and vegetable crops causing great crop losses range from 5 -100 %. Methods of control include resistant varieties, good crop husbandry practices, crop rotation, nitrogen fertilization and use of herbicides. Mesquite and aquatic weeds are also among the most important weeds in irrigated sector.

Key word: Weed control, Field crops, Horticultural crops, Sudan, Herbicides, parasitic weeds

Plenary 4: Advantages of early season weed control in crop enhancement and yield

Chilenga Chama & Leon van Wyk

Syngenta Crop Protection, Schwarzwaldallee 215, CH-4058, Basel, Switzerland

Apart from the traditional competition effect of weeds on crops, there are fundamental crop physiological advantages for early weed management to ensure crop enhancement and yield maximization. Early intervention in weed control ensures optimal control and reduces weed competition with the crop for nutrients, water and sunlight. Some weeds can also be allelopathic to crops as well as be hosts to diseases and insects which subsequently impact on crop development and yield. Apart from this, weeds can also alter some physiological processes in crops due to stresses they exert on the crop which can impact on yield. Fundamentally it is much easier to control weeds when they are small and less competitive with the crop in order to maximize the yield potential of a crop. The optimal timing for herbicide application is therefore pre emergence of the weeds. Most weeds are also at their most susceptible stage early in their life-cycle.

In crops such as maize, there is a definitive “switching point” in the development of the crop, and beyond this point, if weed control has not been effective, there will be a yield penalty. Herbicide resistance management is another aspect to consider in weed management. Young weeds are much more sensitive to herbicides than bigger weeds and therefore less difficult to control. Application timing therefore has a great impact on the efficacy of herbicides, effective dose rates that can be applied, the potential development of resistance, and physiological characteristics of the crop plant.

Key words: Crop enhancement, yield potential, allelopathic, “switching point”, pre emergence, herbicide resistance, efficacy, dose rate

1.2.1 Towards Responsible and Efficient Application of Herbicides in Mechanized Rainfed Farms- Eastern Sudan

Lotfie A. Yousif, Amin Khidder Balla and Magdi Ahmed Bakhiet

Mechanized rain-fed farms in Gedarif State are the most important crop production area in Sudan. In this region, large schemes are grown annually by sorghum, sesame and sunflower. Efficient weed management is the key element of improving crops yield. Due to shortage in manual labor besides large cultivated areas coupled with the necessity to control weeds in a short period of time; chemical weed control is recently introduced in these mechanized rain-fed farms. The use of herbicides volume is increasing annually and the total sprayed area is about one million hectare. A number of herbicides have been recommended by Agricultural Research Corporation for effective weed control in this area. The efficient use of herbicide is greatly reduced due to improper application. Proper application implies safe and correct application of herbicides to reach the definite goal at the exact dose and in optimum time. Improper application of herbicides might be hazardous to environment, reduce efficiency, cause crop injury and reduce profits. This paper reports the current status of herbicide application in mechanized rain-fed farms and the common problems associated with improper application of herbicides in terms of over or under dose, drifts, lack of technical know-how, use of inappropriate machinery and improper calibration. Application timing and weather conditions beside absence of guidance and follow up are the main factors behind the improper application. Urgent and quick interventions are needed to improve herbicide application and avoid the negative consequences of improper application.

Keywords: Sprayer calibration, efficient herbicides application, minimizing hazards, safety measures

1.2.2 Efficacy of pre-emergence herbicide atrazine for weed control in maize

Khogali Izzeldin Idris¹, Dafalla Ahmed Dawoud², Hassan Abdelgadir², Rwada Y. ElHabieb² and Lubna E. Khidir²

1 Agricultural Research Corporation, Shambat Research Station, B. O. Box 30, Khartoum North, Sudan.

2 Agricultural Research Corporation, Gezira Research Station.

A field trial was conducted, at Gezira Research Station Farm, for two seasons (2010/2011 and 2011/2012), to evaluate the activity and selectivity of the pre-emergence herbicide Oxatryne 500SC (atrazine) for weed control in maize. The product was tested at 0.15, 0.20, 0.25 and 0.30 kg ai/fed. Weeded and unweeded plots were included as controls for comparison. Some herbicide-treated plots received supplementary hand weeding at 4 weeks after sowing. The tested herbicide gave very good control of broadleaved weeds. However, its activity against grassy weeds was poor. In both seasons, irrespective of supplementary hand weeding, the herbicide Oxatryne 500SC at all rates used significantly reduced weed air-dry weight. Supplementary hand weeding to the herbicide treatments improved weed control in comparison to the respective treatment without supplementary weeding. All herbicide treatments showed good selectivity to the crop. Yield reductions as a result of unrestricted weed growth were 81 and 74 %, in the first and the second season, respectively. In both seasons, the herbicide, irrespective of supplementary hand weeding, increased maize yield significantly compared to the untreated control. Herbicide treatments with supplementary weeding gave comparable maize grain yield to the weeded control treatment.

Key words: Pre-emergence herbicide, atrazine, maize, weed control

1.2.3 Efficacy and selectivity of S-metolachlor + terbuthylazine and S-metolachlor + atrazine for weed control in maize (*Zea mays* L.)

¹ Kamal, A. M. Bedry, ² N. E. K. Abdalla¹ and ³ R. Y. El Habieb

1 Soaba Research Station

2 Shendi Research Station

3 Gezira Research Station

An experiment was conducted at Merowe and Shendi Research Stations for two consecutive seasons commencing 2010/11, to evaluate the efficacy and selectivity of Gardoprim plus Gold 500 SC (s-metolachlor 312.5 + terbuthylazine 187.5) and Primextra Gold 720 SC (s-metolachlor 400 + atrazine 320) for weed control in maize. The herbicides were applied as pre-emergence treatment. Unrestricted weed growth, significantly reduced grain and straw yields of maize by 45%-82% and 29% - 78%, respectively, compared to the weeded control. The herbicides at all rates showed no phytotoxicity effects on crop growth. The herbicides displayed good (73%) to excellent (100%) control of grasses, and excellent (91% - 97%) control of broadleaved weeds. All herbicides treatments increased seed yield by 266% - 364% and straw yield by 218% - 301% over the un-weeded control and gave comparable

yields to the weed-free control.. No residues of s-metolachlor, atrazine and terbuthylazine were detected in tested samples.

Key words: Gardoprim plus Gold, Primextra Gold, Weed control, Herbicides, Maize

1.2.4 Effects of S. metolachlor 312.5/terbuthylazine 187.5 on pre emergence weed control in sorghum

Hassan Abdelgadir, Dafalla A.Dawoud, Mohammed Elkhawad, Lubna EL. Khidir and Rawda Y. EL Habieb

Weed Research Programme, Crop Protection Research Centre , Gezira Research Station. Agricultural research Corporation

The efficacy and selectivity of Gardoprim plus Gold 500 SC (S. metolachlor 312.5/terbuthylazine 187.5), with or without safener (Concep III 960 EC at 0.4 ml and 20ml water/kg seeds) was evaluated for pre-emergence weed control in sorghum. Field experiments were conducted for three seasons (2010/ 2011, 2011/ 2012 and 2012/ 2013) at Gezira Research Farm . The herbicide treatments were arranged in RCB design with four replicates in each season. Herbicide was applied at a volume rate of 100- 130 L/fed through- out the seasons. Gardoprim plus Gold, at low rates, displayed poor to moderate control of grasses but, at the high rates, the herbicide gave moderate to excellent (54- 97%) control of grasses. The activity of this herbicide against broadleaved weeds was good to excellent (71- 100%) throughout the seasons. Gardoprim plus Gold at all rates with unsafened seeds showed significant reduction in sorghum plant population. However, when the seeds were treated with the safener Concep III 960 EC, the phytotoxicity effects on sorghum plant disappeared. Gardoprim plus Gold at all rates, with safened seeds, out-yielded the unweeded control treatment by up to 54% and attained yield comparable to that of the weeded control treatment. The results of herbicides residues indicated that no residues of s-metolachlor and terbuthylazine were detected in all samples

Key words: Sorghum, Herbicide, Herbicide safener, ConcepIII. Gardoprim plus Gold 500 SC

1.2.5 Effects of pre-sowing irrigation followed by glyphosate application on weed control and wheat yield.

Abosofian S. Osman¹, M. El khawad² and Dafalla A. Dawoud²

1 New Halfa Research Station

2 Gezira Research Station

This study was conducted at New Halfa Research Farm, for three seasons, (2007/08-2009/010) to evaluate the effect of pre-sowing irrigation on weed control and growth and yield of wheat. After pre-sowing irrigation, some plots were sprayed by different rates of the herbicide glyphosate after two weeks from weed emergence. Weeded and un-weeded controls with or without pre-sowing irrigation were included for comparison. Treatments were arranged in a randomized complete block design with 4 replications. Pre-sowing irrigation followed by glyphosate application was more effective in controlling weeds than the other treatments. Pre-sowing irrigation followed by glyphosate or by one hand weeding, significantly, increased straw yield compared to the unweeded controls. Pres-owing irrigation followed by glyphosate application, irrespective of the herbicide rate, increased wheat grain yield by up to 59 % compared to the un-weeded control plots and gave more yield than the weeded control plots..

Key words: Pre-sowing irrigation, wheat, glyphosate, weed control

1.2.6 Evaluation of pyroxsulam for post-emergence weeds control in wheat

Kamal. A. M. Bedry¹; L. El Khidir² and R. Y. El Habieb²

1 Soaba Research Station

2 Gezira Research Station ARC, Crop Protection Research Centre

An experiment was conducted in 2009/10 and 2010/11 seasons at Tengasi and Merowe Research Farm (MRF) sites to evaluate the efficacy and selectivity of the herbicide Pallas 45 OD (pyroxsulam) for post-emergence weed control in wheat. Unrestricted weed growth reduced grain yield of wheat by up to 100% compared to the weed-free control. The herbicide Pallas 45 OD, at all rates, gave very good to excellent (80% - 94%) control of broad-leaved weeds and excellent (95% - 100 %) control of grasses. The herbicide, significantly, decreased weed air-dry weight by 95% - 99% compared to weedy control. All herbicide treatments resulted in yield and yield components comparable to the hand-weeded control. The herbicide Pallas at 0.0042 kg a.i. feddan⁻¹ can be used effectively and safely for weeds control in wheat in Northern State of Sudan.

Key words: Weed control, wheat, post-emergence herbicide, Pallas 45 OD

2.2.1 Chemical Control of Wild Sorghum (*Sorghum arundinaceum*(Del.) Stapf.) in Faba Bean (*Vicia faba* L.) in Northern Sudan

Kamal. A. M. Bedry, Abbas E. M. Elamin and Ihsan A. Abbas

Soaba Research Station, Soaba, Sudan

e-mail: kamal.bedry6@gmail.com

An experiment was conducted at Merowe Research Station farm, in the Northern State, Sudan, during 2008/2009 and 2009/2010 seasons. The objectives of the experiment were to determine the damage inflicted by wild sorghum (*Sorghum arundinaceum* (Del.) Stapf.) on the yield of faba bean (*Vicia faba* L.) and to evaluate the efficacy and selectivity of the post-emergence herbicide clodinafop-propargyl (Topik) on wild sorghum and its effect on faba bean yield. The wild sorghum reduced faba bean crop stand by up to 76 %. It reduced straw and seed yields by 76% -79% and 88% - 91%, respectively. The herbicide clodinafop-propargyl (Topik) showed no phytotoxicity effect on faba bean crop. The herbicide, at all rates, effected complete (100%) and persistent control of the wild sorghum and resulted in faba bean seed yield comparable to the hand-weeded control. The lowest dose (0.075 kg a.i./ha) of the herbicide used was equal to 75% of the dose recommended for the control of wild sorghum in wheat. The herbicide topik at 0.075 kg a.i. /ha could be used effectively and safely for wild sorghum control in faba bean

Key words: Wild sorghum, faba bean, Herbicide, Clodinafob-propargyl, northern Sudan

¹Gezira Research Station, Agricultural Research Corporation, Wad Medani

2.2.2 The efficacy and selectivity of the herbicide oxyfluorfen for weed control in potato (*Solanum tuberosum* L.) in northern Sudan

Kamal A. M. Bedry¹, R. Y. El Habieb¹, M. A. Ahmed¹ and E. A. Abdelatif²

1 Agricultural Research Corporation Wad Medani, Sudan.

2 University of Gezira, Wad Medani, Sudan.

E-mail: Kamal.bedry6@gmail.com

Field experiments were conducted at Elsaggai and Merowe, Northern State, Sudan, during the period 2007 to 2009 to evaluate the efficacy and selectivity of the herbicide Goal (oxyfluorfen) for weed control in potato. The herbicide was applied at 7 or 14 days after planting. Unrestricted weed growth reduced potato total and marketable yields by 50% - 84% and 54% - 97%, respectively. Regardless of the time of application, the herbicide goal at all rates gave excellent and persistent control of grasses and moderate to excellent control of broad-leaved weeds. It also reduced air-dry weight of weeds by up to 97%. Goal at all rates, applied 7 or 14 days after planting, increased total and marketable yields of potato by 59% - 100% and 82% - 200%, respectively. The herbicide Goal can be used effectively and safely for weed control in potato in northern Sudan.

Key words: Potato, weed control, herbicide, northern Sudan

2.2.3 Selectivity of pendimethalin, oxyflourfen and oxadiazon to onion as influenced by soil type and crop growth stage

Nasr Eldin K. Abdalla¹ and A.G.T. Babiker²

1 Agricultural Research Corporation, Shendi Research Station, Shendi, Sudan

2 Sudan University of science and technology, College of Agricultural Studies, Khartoum North, Sudan

Corresponding author Babiker, A. G. T. agbabiker@yahoo.com

Onion is a major vegetable crop in the Sudan and is produced in a wide array of soils. The herbicides pendimethalin, oxadiazon and oxyfluorfen are recommended for weed control in transplanted onion. However, selectivity of herbicides is influenced by several factors including soil type, herbicide rate and plant growth stage. In the present study a series of greenhouse experiments was undertaken to investigate the influence of soil type, herbicide rate and growth stage on selectivity of pendimethalin, oxyflourfen, oxadiazon and their tank mixtures to onion. The herbicides were applied immediately after sowing or at 1-4 weeks after emergence. Treatments effects, whenever relevant, were assessed by determining days to 50% emergence, seedlings fresh weight and mortality. Pendimethalin, at all rates, delayed seedling emergence in Sand, but had no effects in Kuro soils. In Gerf and High terrace soils emergence was significantly obstructed at the high rates. Oxyfluorfen did not affect seedling emergence in Kuro soil, but tended to shorten emergence time in Sand, Gerf and High terrace soils. Oxadiazon had little effects on seedling emergence in Kuro, High terrace and Gerf soils. However, in Sand the high rates were inhibitory. Pendimethalin, at all rates, reduced seedlings fresh weight significantly in Sand and high terrace soils. However, on Kauro and Gerf soils, significant reductions were only achieved at the high rates. Oxyfluorfen and its tank mixtures with pendimethalin applied 1-3 weeks after crop emergence (WACE)

reduced seedlings fresh weight by 10-52% and effected high seedling mortality (40-90%). Treatments made at 4 WACE were less suppressive. Oxidiazon and its tank mixtures with pendimethalin, applied 1 WACE, reduced seedling fresh weight by 23-46% and resulted in low to moderate mortality (11-27%). Treatments made 2-4 WACE had negligible effects. In conclusion selectivity of pendimethalin, oxyflourfen, oxadiazon and their tank mixtures to onion is not a fixed property of the herbicides, but varies with soil type, herbicide rate and crop growth stage.

Key words: Hebicides, Vertisols, alphasols, antisol high traces, post-emergence Herbicides, Mortality

2.2.4 STUDIES ON CHEMICAL WEED CONTROL IN GUAR (*Cyamopsis tetragonoloba* L.)

Abbassy, M.A., S.T. El-deeb, M.A.Marzouk, F.S.I.Sabra, M.A.F.AbuZeid

A field experiment was conducted at El-Bostan experimental farm- faculty of Agriculture-Damanhur University – Egypt. during summer 2010. The objective of the study was to study the efficacy and selectivity of different herbicides for weed control in guar (*Cyamopsis tetragonoloba* L.). The experiment consisted of 13 herbicide treatments along with weeded and un-weeded control. The experiment was laidout in randomized block design with three replications.

Among the herbicides tested, oxadiazole, brominal, , diuron, linuron, metribuzin and bentazone caused minor visual injury to guar.

The weed count and dry weight of weeds were found to be maximum in un-weeded control. Among the tested herbicides the mixture of butralin+ diuron recorded lower weed biomass followed by pendimethalin, oxadiazole and butralin. The herbicides fluazifop-p-butyl and isofop recorded lower grasses biomass

Unrestricted weed growth significantly reduced plant height, leaf dry weight, stem dry weight and total dry weight. The herbicide treatments pendimethalin and butralin+ diuron significantly increased these parameters and gave comparable results to weed free treatment. The pod yield decreased significantly due to weed competition. The herbicides, pendimethalin and butralin+ diuron increased pod yield significantly and gave comparable yields to weed free check.

Key words: guar, *Cyamopsis tetragonoloba* L, weed control, herbicides, Egypt

2.2.5 Efficacy of some selected herbicides on mesquite as influenced by age, and application method.

E.A. Ahmed¹ and A. G.T. Babike²

1 Agricultural Research Corporation, Sennar Research Station

2 Sudan University of Science and Technology, College of Agricultural Studies

Prosopis juliflora (common mesquite), an alien invasive plant, has become a serious weed that threatens agriculture, pastoralism and biodiversity in Sudan. The infested area is estimated to be around 500 thousand hectares. A series of experiments was undertaken in greenhouse grown and in a natural mesquite stand at the Gezira Research Station and the Gezira University. The objectives of the experiment were to study the herbicidal efficacy of 2,4-D, glyphosate, clopyralid and triclopyr on mesquite. Using 1-3 months old mesquite seedlings clopyralid, irrespective of rate of application (0.6-2.38 kg a.e. ha⁻¹), and seedling age effected high mortality (70-100%) of mesquite seedlings.

Herbicidal efficacy of triclopyr, on the other hand, increased with application rate and seedling age. One month after treatment, triclopyr at the lowest rate (0.6 kg a.e.ha⁻¹) gave 30% and 55-63% mortality of 1 month and 2 months old seedlings, respectively. However, at 3 months after treatment high mortality (78-100%) was achieved, irrespective of rate of application. Clopyralid and triclopyr at 0.6 – 1.2 kg a.e. ha⁻¹, each, applied to foliage of 4 months old seedlings effected excellent (90 – 100%) suppression of the weed. 2,4-D (0.76 and 1.52 kg a. e. ha⁻¹) and glyphosate (0.86 and 1.71kg a. e. ha⁻¹) were, however, less effective (6-53% mortality). Triclopyr, at 1.25 and 2.5% (v/v) in a 30% diesel water mix, applied as basal treatments to mature mesquite trees, resulted in up to 100% mortality 3 months after treatment. A tank mixture of triclopyr and clopyralid (1.25 + 1.25% v/v) made in 30% diesel water mixture, applied as basal treatment, was more effective in controlling mesquite trees than clopyralid at 2.5 % (v/v). Clopyralid and triclopyr each at 1, 2 and 3 % (v/v) applied as aqueous foliar treatments to naturally grown mature mesquite trees effected complete mortality (100%) 3 months after treatment. Clopyralid and triclopyr, each alone or in tank mixtures, achieved excellent control of mesquite seedlings and mature trees. Glyphosate and 2,4-D were, however, less effective.

Keywords: 2,4-D, triclopyr, clopyralid, glyphosate, *Prosopis juliflora*, mortality

2.2.6 Effects of thidiazuron 360 g/L+diuron 180g/L and thidiazuron on leaves of cotton defoliation

Hassan Abdelgadir, Dafalla A.Dawoud and Mohamed ElKhawad

Weed Research Programme, Crop protection Research Centre, Agricultural Research Corporation

Cotton (*Gossypium* spp) is the main cash crop in the Sudan. The presence of the cotton leaves during harvest impede mechanical picking and contaminate the cotton lint during picking and consequently reduce the quality of the cotton. The objective of this work was to evaluate the activity and efficacy of the defoliant, Total Drop 54SC and Defol 50 WP, on leaves of cotton. Two experiments were conducted at Gezira Research Farm during three seasons 2009/2010, 2010/2011 and 2011/2012 using cotton cultivar, each cultivar, Acala Barac (67) B or Hamid was sown in a separate experiment. The defoliant, Total Drop at 0.056, 0.075, 0.094 and 0.113kg a.i. /fed. and Defol at 0.143, 0.190, 0.238 and 0.285 kg a.i. /fed. were applied when 70-80% bolls of cotton were opened. The defoliant were applied as aqueous sprays by a motorized sprayer at a volume rate of 471- 680 L/fed. Unsprayed control was included for comparison. Treatments effects were assessed by counting the average number of leaves / plant out of 10 plants / treatment chosen randomly. In both experiments leaves defoliation was increased with increasing time after defoliant application. The defoliant, Total Drop and Defol, gave excellent and persistent leaves defoliation of cotton leaves within 4 weeks after defoliant application. The defoliation of leaves of cotton cv Barac (67) B reached 90- 97, 81- 95, and 89- 95% within 4 weeks after defoliant application in season 2009/2010, 2010/2011 and 2011/2012, respectively, The defoliation of leaves of cotton cv Hamid reached up to 94- 97, 92-97 and 94- 97% within 4 weeks after defoliant application in season 2009/2010, 2010/2011 and 2011/2012, respectively. The defoliation of leaves of cotton will ease facilitate use of machine for picking whereby reduces cost of production and at the same time, contamination of cotton lint with dry cotton leaves, other impurities and foreign bodies.

Key words: Cotton, defoliant, Total Drop 54SC, Defol 50 WP

3.2.1 The efficacy and selectivity of the herbicide imazethapyre for *Orobanche* control in faba bean in northern Sudan

Kamal. A. M, Bedry¹, Elsadiq S. Mohamed², and Ihsan, A. Abbas²

1 *Soaba Research Station*

2 *Gezira Research Station ARC, Crop Protection Research Centre*

The parasitic weed, Broomrape (*Orobanche* spp.), is one of the major problems facing food legumes production in different parts of the world. *Orobanche crenata* causes considerable yield losses in faba bean in Sudan. *Orobanche crenata* Forsk. was first reported on faba bean in Sudan in 2001/2002 at El Debeiba in Merowe locality in northern Sudan. An experiment was conducted in 2008/09, 2009/10 and 2010/11 seasons in *Orobanche*-sick plot at Merowe Research Farm to determine the activity and selectivity of the herbicide imazethapyre (Pursuit 10% E.C) on *Orobanche crenata* Forsk. control and faba bean seed yield in northern State. The herbicide Imazethapyre at 0.042 kg a.i /fed applied 21 days after planting (DAP), significantly reduced the number and air-dry weight of *O. crenata* by 71% - 84% and 76% - 87%, respectively and increased faba bean seed yield by up to 172%, compared to the unweeded plot. The herbicide Imazethapyre at 0.042 kg a.i /fed applied 21 DAP can be used effectively and safely for *Orobanche* control in faba bean in northern Sudan

3.2.2 Effects of Chlorsulfuron and Nitrogen on *Striga* Incidence and Sorghum Growth and Yield

Rashida Abusin^{1*}, Alfatih Ahmed², Abdel Gabar Babiker³

1 University of Bahri, Department of Plant Protection, Faculty of Agriculture, Alkadaro, Khartoum North, Sudan.

2 Agricultural Research Corporation, Sinar Research Station

3 Sudan University of Science and Technology, College of Agricultural Studies, Sudan

Corresponding author: rashidaabusin@hotmail.co

The root parasitic weed *Striga hermonthica*, is a major constraint to cereals production in Sudan. Research, over a century, revealed no universal method of control. The present investigation was undertaken at Senar State to evaluate the effects of nitrogen, the herbicide chlorsulfuron, each alone and in combinations, on *striga* incidence and sorghum growth and yield. At 45 days after sowing (DAS) nitrogen at 43.8 and 87.6 kg ha⁻¹ reduced *Striga* emergence by over 70% whereas chlorsulfuron at 2.38g and 2.98g kg a.i. ha⁻¹ reduced emergence by 53.4 and 75.6%, respectively. Nitrogen followed by chlorsulfuron, irrespective of herbicide or fertilizer rate, resulted in excellent suppression of the parasite emergence (83.7-100%). At 60 DAS the untreated control had 13 plants m⁻². Nitrogen at 43.8 and 87.6 kg ha⁻¹ suppressed *Striga* emergence by 46 and 69%, respectively. The herbicide at 2.38g and 2.98g a.i. ha⁻¹ reduced *Striga* emergence by 77%. The combinations chlorsulfuron and nitrogen, at all rates reduced *Striga* emergence by 77- 92%. At 90 DAS, *Striga* emergence was 24 plants m⁻² in the untreated control. Chlorsulfuron, alone, and in combination with nitrogen reduced the parasite emergence by 45.6-50%. Unrestricted *Striga* parasitism resulted in the lowest sorghum straw fresh weight (5.31 t ha⁻¹). All treatment outyielded the untreated

control. Chlorsulfuron at 43.8 g a.i. ha⁻¹ applied subsequent to nitrogen at 87.6 Kg ha⁻¹ outyielded the untreated control significantly. Unrestricted *Striga* parasitism resulted in low grain yield (769 kg ha⁻¹). Nitrogen at 43.8 and 87.6 kg ha⁻¹ increased grain yield by 7 and 143%, respectively. Chlorsulfuron at 2.38 and 2.98 g ha⁻¹ increased grain yield by 120 and 140%, respectively. Of all treatments chlorsulfuron at 2.38 g ha⁻¹ when preceded by nitrogen at 87.6 kg ha⁻¹ gave the highest yield (2838 kg ha⁻¹). All treatments suppressed *Striga* emergence and improved sorghum growth and yield in comparison to the control. Chlorsulfuron, at the lowest rate (2.38 g ha⁻¹) in combination with nitrogen at 87.6 kg ha⁻¹ was the best treatment.

Keywords: Grain yield, straw yield, Root parasitic weeds

3.2.3 Chlorsulfuron + 2,4-D as herbicide mixture for *Striga* control in sorghum

Abbasher^{1*} A. A., Adam², G. A., Babekir³, A. E., Zaroug¹. M. S., Ahmed¹, A. E

1 Plant Pathology department, Faculty of Agriculture & Natural Resources

2 Crop protection Department, Elrahaad Sckeme

3 Crop Protection Department, Faculty of Agricultural Studies.

* = Corresponding author, basherawad@yahoo.co.uk

A series of experiments were conducted during the years 1999/2000 and 2000/2001 to study the efficacy and selectivity of the herbicide chlorsulfuron in tank mixtures with 2,4-D for *Striga* control in sorghum. Application of the nitrogen fertilizer, as urea, was also evaluated as a separate treatments or in combination with the herbicide mixtures. The experiments were conducted at the Gezira Research Station, Madani, Gezira State, Sudan. Application of N, as urea, had slight effects on *Striga* emergence at 60 days after sowing. At 90 DAS, urea at 80 kg/fed reduced *Striga* emergence by up to 37%. Chlorsulfuron +24-D reduced *Striga* emergence by 33 and 67% at 60 and 90 days after sowing, respectively. Urea at 80 kg/ fed plus the herbicide mixture (Chlorsulfuron +24-D, at different rates) reduced *Striga* emergence by up to 61 and 72% at 60 and 90 days after sowing, respectively. Urea and herbicide mixture, each alone, displayed in consistent effects on *Striga* dry weight. Urea at 80 kg/fed followed by herbicide mixture resulted in the highest reduction of *Striga* dry weight (up to 74%). Urea, herbicides and their combinations resulted in non-significant increase of sorghum grain and straw yields.

Key words: *Striga hermonthica*, herbicides, urea fertilization, sorghum

3.2.4 Evaluation of resistance of upland rice varieties to *Striga hermonthica* through laboratory, pot and field experiments

Hiroaki Samejima^{1*}, Chizu Yoshimoto¹, Ahmed El Mustafa² Abdel Gabar T. Babiker³ and Yukihiro Sugimoto¹

1 Graduate School of Agricultural Science, Kobe University, Nada, Kobe 657-8501, Japan

2 Agricultural Research Corporation, Wad Medani. Sudan

3 College of Agricultural Studies, Sudan University of Science and Technology, P. O. Box 71, Shambat, Khartoum North, Sudan

Striga hermonthica (Del.) Benth., an Orobanchaceae, is an obligate root hemi-parasite that infects most of the economically important cereal grasses in Sub-Saharan Africa. The

parasite, a difficult to control weed, causes severe reduction in grain yield. Host resistance is advocated as the simplest and easiest method of control. A series of laboratory, greenhouse and field experiments was conducted to select for *S. hermonthica* resistant among 52 rice varieties and to identify the specific mechanisms associated with resistance. Pre-attachment resistance was evaluated by assessing germination inducing activities of root exudates whereas post-attachment resistance was investigated using the rhizotron technique. Results were validated under artificial *S. hermonthica* infestation, in greenhouse and field experiments in Sudan, the target environment. The results indicated prevalence of differential resistance in the rice varieties tested. However, Umgar, a released variety for commercial planting in Sudan, and NERICA5, an early maturing variety, exhibited strong and durable post-attachment resistance associated with barriers at cortex, endodermis and stele. Umgar possessed additional mechanism(s) that inhibit growth of the parasite subsequent to connection with the host xylem. Umgar would-be suitable for *S. hermonthica* endemic areas where judicious irrigation is feasible, whilst the early maturing variety, NERICA5 would be appropriate for *Striga* stricken areas where water shortage is experienced. Prevalence of resistance in the rice varieties, including Japanese locals, offers a huge gene pool suitable for further studies targeting pyramiding resistance.

Keywords: resistant variety, rice, *Striga hermonthica*, target environment

3.2.5 Integrated *Striga* Management to Improve Sorghum Productivity in subsistence farming system at marginal rainfed areas of the Sudan

Dafalla A. Dawoud¹, E.A. Ahmed¹, A.H.A. Assar¹, A. ElSir¹ and A.G.T. Babiker²

1 Agricultural Research Corporation, Wad Medani, Sudan

2 College of Agricultural Sciences, Sudan University of Science and Technology, Khartoum North, Sudan

The marginal rainfall area of the central clay plain of the Sudan is characterized by subsistence farming in which sorghum is the major crop. The main production features of the area are low soil fertility, low and intermittent rainfall, limited use of inputs, sorghum monocropping and heavy infestations by the root parasitic weed *Striga hermonthica*. The latter, represents the main biological constraint to sorghum productivity in the area. Management efforts in farmer's field are limited. The present study was undertaken, in subsistence farmers' fields on the marginal rainfall area of the central clay plain of the Sudan, to evaluate a series of management packages. A *Striga* tolerant sorghum cultivar (Arfagadamak) and water harvest, using tied ridges are common components shared by all packages. Superimposed on these components were urea at 95 kg ha⁻¹ applied at planting and hand-pulling of *Striga* plants undertaken every two weeks, henceforth referred to as package I. Package II comprised, in addition to the common components, of urea at 95 kg ha⁻¹, applied at sowing, followed by 2,4-D at 0.76 kg ae ha⁻¹ applied four weeks after sowing. Package III employed, intercropping with cowpea in addition to the common components. The packages were compared for efficacy with farmer's practices where sowing, on flat, of local land races, with no inputs is the traditional norm. The results revealed that the three packages significantly reduced *Striga* emergence in comparison to farmer's practices. Package I was the most accepted by framers since 2,4-D, in package II, damaged wild okra, a plant of economic importance to farmers, while cowpea in package III was seriously damaged by the local insect fona.

Key words: Striga control, semi-arid, parasitic weed, soil fertility, water harvesting, sorghum, resistant varieties, intercropping, herbicide, fertilizer

3.2.6 Effects of Seed Placement in Soil on Virulence of *Orobanche crenata* on Faba Bean

Amani, A; Hamid, S. A. and Babiker, A. G. T
College of Agricultural Studies, Sudan University of Science and Technology, Khartoum,
Sudan Box, 72. www.sustech.edu.

The root parasitic weed *Orobanche crenata* Forsk, a major constraint to leguminous crops, especially faba bean (*Vicia faba* L.), production was recently introduced into Sudan. Because of its invasive nature the plant has become a pest of national importance. The present investigation, undertaken at the College of Agricultural Studies, Khartoum North, was set to investigate the effects *Orobanche* seed placement in soil on the parasite virulence and influence on faba bean growth. Seeds buried at a depth of 5 cm resulted in the heaviest infestation and highest emergence of the parasite. Seed placement at 10 and 15 cm soil depths did not impair the parasite attachment, but reduced emergence. *O. crenata* from seeds placed in the surface soil displayed late emergence and produced no seeds, whereas those from seeds buried at 5 and 10 cm depths produced considerable number of capsules (16-29 capsules/plant). *O. crenata* shoots from seeds placed at 15 cm soil depth remained subterranean and produced no seeds. *O. crenata* infestation from seeds placed in the surface soil had no adverse effects on faba bean growth attributes. However, those from seeds buried at 5, 10 and 15 cm reduced all measured growth attributes and infestation resulting from seeds placed at 5 cm depth was, invariably, the most damaging. The results suggest that in newly infested areas soil inversion or adoption of no-till curtail replenishment of the parasite seed bank and reduce crop damage.

Key words: *Orobanchaceae*, *Vicia faba*- soil depth

Corresponding author Babiker, A. G. T. e. mail agbabiker@yahoo.com

4.2.1 Biological control of *Striga hermonthica* by soil microorganisms

Hassan, M.M¹, Abdelgani, M. E¹., Osman, A. G¹., Rugheim, A.M.² and Babiker, A. G. T.³

1 Environment and Natural Resources Research Institute, the National Centre for Research, Khartoum, Sudan.

2 Faculty of Agriculture, Omdurman Islamic University, Omdurman, Sudan.

3 College of Agricultural Studies, Sudan University of Science and Technology, Khartoum, Sudan

Corresponding author: meabdelgani@gmail.com

Striga, an obligate root parasitic weed, has become the greatest biological constraint to food production in Africa. Crop yield losses of 100% are not uncommon under heavy infestations. In Sudan, *S. hermonthica* is a common weed in most of cereals' growing areas. Many potential methods of control including physical, cultural, chemical and biological were developed. However, so far these methods have had only a limited impact on the parasite. To-day there is no single cost-effective method that can effectively solve the problem.

Furthermore, most of the methods available, are either time consuming or unaffordable by small subsistent farmers. Our work aimed at finding soil borne microorganisms which have the potential to reduce *Striga* infestation through suppressing seeds germination and/or early developmental stages of the parasite. Microorganisms might also enhance suicidal germination in absence of or away from the host roots. In a series of laboratory and glass house experiments, 317 bacterial and 64 soil born fungal isolates and strains were evaluated for their effects on germination and haustorium initiation of *S. hermonthica*, the sorghum strain. Fifty four bacterial isolates and strains were selected as most effective. Combinations of bacteria, bacterial interactions with sorghum cultivars, mycorrhiza and soil-N level were also investigated. Some bacteria enhanced *Striga* seeds germination significantly in the absence of host plant and others were found to suppress germination and/or haustorium initiation even in presence of hosts. The bacterial strains *Pseudomonas putida*, *Bacillus spp.* and the bacterial isolates M20, S23, S22, GSL, D8, G11, D20 and D50 reduced *Striga* incidence by 90-100% at 12 week after sowing in comparison to the infested un-treated sorghum control. A combination of the bacterial strains inhibited *Striga* seeds germination by 18 to 34% while some individual bacteria inhibited germination by 2 to 10% in comparison to the corresponding controls. Similar results were obtained with 27 soil fungal isolates and strains of which more than 18 are currently under investigation. On *S. hermonthica* from sugar cane, 34 bacterial isolates and strains were evaluated for their effects on germination and haustorium initiation of *Striga* under laboratory conditions. Eight isolates and strains were effective and have been selected for further work.

Key words: Germination and haustorium initiation, Soil born fungi and bacteria, sorghum, *Striga*, Sudan.

4.2.2 *Fusarium brachygibbosum* a plausible candidate for deployment as a bioagent for *Striga hermonthica* management in Sorghum.

Rna, A.G. Babiker⁻¹, Dagash, Y. M.⁻¹, Elhussein, A.A.⁻², Abdel Elhalim, T. S.⁻³ and Babiker, A.G.T.⁻¹

1 College of Agricultural Studies, Sudan University of Science and Technology

2 Faculty of science Khartoum University

3 Agricultural Research Corporation, Shambat research Station

Witchweeds (*Striga* spp.), Orobanchaceae, are depilating root parasitic weeds of important cereals and leguminous crops in the semi-arid tropics. Their virulence, parasitic mode of life and the damage they inflict during early developmental stages make them suitable targets for biocontrol using bioherbicides. The present investigation was undertaken at the College of Agricultural Studies, Sudan University of Science and Technology to evaluate virulence and suppressive effects of selected *Fusarium* isolates obtained from diseased *S. hermonthica* plants and cultured in a Czapek broth medium. The isolates, applied during conditioning showed differential suppression of the parasite germination. *Striga* seeds conditioned in isolates 2, 3 and 6 displayed negligible germination (0-5%) irrespective of GR24 concentration. Isolates 1, 4, 5 and 7 were less suppressive and germination increased with GR24 concentration. Among all isolates number 7 was the least suppressive and germination was 51, 76 and 89% in response to GR24 at 0.001, 0.01 and 0.1 ppm, respectively. The corresponding germination for seeds conditioned in the *Fusarium* free medium was 77, 83,

and 89%. Seeds conditioned in the control medium for 5, 10 and 15 days and subsequently challenged with GR24 at 0.001, 0.01 and 0.1 displayed 89, 96 and 89% germination. The corresponding germination figures for those conditioned in a medium inoculated with isolate 2 were 70, 3 and 6%, whereas those for isolate 3 were 58, 12 and 6%. For seeds conditioned in the control medium radicle length increased with GR24 concentration and with the conditioning time. All isolates reduced radicle extension significantly and the observed reduction increased with conditioning time. Validation of the results in a series of a greenhouse experiments showed that the efficacy of isolate 2, identified as *F. brachygibbosum*, increased with inoculum size and decreased with *Striga* seed bank. At the highest fungal inoculum size (10g/pot) *Striga* emergence was abolished at the lowest seed bank and reduced to 25% at the highest seed bank level. Nitrogen increased the efficacy of the fungus. The combinations nitrogen and *F. brachygibbosum* delayed *Striga* emergence, reduced infestation and improved sorghum growth and dry matter yield. The study, showed the importance of *Striga* seed bank as a key factor in determining the response to treatments and losses in dry matter yield. Furthermore, the study reported, for the first time, isolation of the fungus *F. brachygibbosum* from diseased *Striga* plants and showed that the fungus is highly suppressive to *Striga* germination, radicle length and emergence. Moreover, the fungus improved sorghum growth and dry matter yield. The study further suggests the plausibility of deploying *F. brachygibbosum* as a component of an integrated *Striga* management Strategy in sorghum.

Key words: Fungal isolate, *Fusarium brachygibbosum*, conditioning, *Striga* seed bank

4.2.3 Fungi as Candidates for Biological Control of Broomrape (*Phelipanche ramosa* L.) in Tomato (*Solanum lycopersicon*).

Yahia, M.A.¹, Hassan, M.M.², Ali, T.E.¹, Rugheim, A.M.¹, Osman, A. G.², Abdelgani, M. E² and Babiker, A.G.T.³

1 Faculty of Agriculture, Omdurman Islamic University, Omdurman, Sudan.

2 Environment and Natural Resources Research Institute, the National Centre for Research, Khartoum, Sudan.

3 College of Agricultural Studies, Sudan University of Science and Technology, Khartoum, Sudan

Corresponding author: mohkadis@yahoo.com

The root parasitic weed *Phelipanche ramosa* is a serious production constraint in vegetables across the world. Among vegetables tomato (*Solanum lycopersicon*) is the most susceptible. In Sudan the parasite is widely spread in the fertile alluvial soils along the Nile banks, particularly in the Gezira and Khartoum States, where tomato is a major cash crop. A series of laboratory and greenhouse experiments were conducted at the Environment and Natural Research Institute, the National Centre for Research in Khartoum to investigate the effect of 27 fungal isolates and a *Trichoderma harzianum* strain on germination and development of *P. ramosa*. Results indicated that the *T. harzianum* strain and isolate K22 and their exudates inhibited germination of the parasite by 89-100%. On the other hand, fungal isolates A1, S14 and M25 induced germination significantly, as compared to the controls. With respect to haustorium initiation the results showed that *T. harzianum* and the fungal isolate K22 completely inhibited haustorium initiation. In contrast the fungal isolates A1 and M25 enhanced haustorium initiation by 45 to 53%. In the greenhouse experiment *T. harzianum*

and the fungal isolate K22 and compost at 20g/7kg soil reduced parasite emergence, increased tomato shoot dry weight and number of fruits as compared to the un-inoculated infested control. In conclusion the fungal isolates K22 and M25 and the *T. harzianum* strain are promising candidates for deployment as components of an integrated management programme for *P. ramosa* on tomato.

Key words: Broomrape, compost, fungi, haustorium initiation, tomato.

4.2.4 Arbuscular mycorrhizal fungi have the potential to reduce infection caused by the parasitic weed *Phelipanche ramosa* L.(Pomel) in tomato

Tilal S. Abdelhalim^{a,c}, A.G .T Babiker^b and Maria R. Finckh^c

^a Horticultural Research Centre, Agricultural Research Corporation (ARC), Wad Medani, Sudan. P.O.box:126

^b Plant Protection Department, College of Agriculture studies, Sudan University of Science and Technology, Khartoum North, Shambat Sudan P.O.box:71

^c Ecological Plant Protection Group. Faculty of Organic Agricultural Sciences, University of Kassel, 37213 Witzenhausen, Nordbahnhofstrasse, Germany

Branched broomrape *Phelipanche ramosa*, an achlorophyllous root parasitic weed on several dicotyledonous crops, is a major constraint to tomato production across the world. Pot experiments were carried out in a glasshouse at the University of Kassel Germany to investigate 1) the effects of *P. ramosa* L. seed bank on tomato growth parameters and 2) to determine if different arbuscular mycorrhizal fungi (AMF) differ in their effects on parasitisation of tomatoes by *P. ramosa* and on subsequent development of the parasite. In the first experiment, different *Phelipanche* seed levels were established by mixing the parasite seeds (0 -32 mg) with the potting medium in each pot. In the second experiment, three AMF: *G. intraradices*, *G. mosseae* and Glomus Sprint[®] were used. Mycorrhiza free *P. ramosa* infested, mycorrhiza infected *P. ramosa* free and *P. ramosa* and mycorrhiza free controls were included for comparison. The results revealed that *P. ramosa* reduced all tomato growth parameters measured and the reduction progressively increased with the amount of seed used. Root and total dry matter accumulation were most affected. *P. ramosa* emergence and the number of tubercles increased with the seed bank and were maximal at the highest seed bank. Numbers of branches of tomato plants were positively correlated with AMF colonization ($R^2=0.52$, $P<0.01$). *P. ramosa* infestation reduced infectivity of AMF. Suppression of *P. ramosa* by AMF varied significantly among AMF species. Inoculation with *G. intraradices*, *G. mosseae* and *G. Sprint*[®] reduced the number of emerged *P. ramosa* shoots by 29.3, 45.3 and 62.7%, respectively, and the number of tubercles by 22.2, 42.0 and 56.8%, respectively. The reduction was significant in case of *G. mosseae* and *G. sprint*[®], but not for *G. intraradices*.

Keywords: *Phelipanche ramosa*, seed bank, tomato plants, Arbuscular mycorrhizal fungi

4.2.5 Influence of root exudates of *Desmodium* sp on *Striga hermonthica* (Del.) Benth and *Orobanche. ramosa* L. germination

Khogali. I. Idris¹, Zeyar R. Khan², and Abdel Gabar E. Babiker³

1 Agricultural Research Corporation, Shambat Research Station, B. O. Box 30, Khartoum North, Sudan.

2 International centre of Insect Physiology and Ecology, Nairobi, Kenya

3 College of Agricultural Studies, Sudan University of Science and Technology

Parasitic weeds of the genera *Striga* and *Orobanche* pose a severe problem for agriculture because they are difficult to control and are highly destructive to several crops. The seeds of these parasitic weeds remain viable in the soil for many years until germination is stimulated by release of a chemical signal from a host or non host plants. A series of laboratory experiments were conducted at Gezira Research Station, Sudan to examine the effects of root exudates of local and exotic *Desmodium* sp on the induction of *S. hermonthica* and *O. ramosa* seeds germination. Five *Desmodium* species; the exotic, *D. uncinatum*, *D. intortum*, *D. distortum*, *D. tortuosum*, and the local species *D. dichotomum*, obtained from Damazin, Sudan were used. This study showed that undiluted root exudates of *D. distrotum* induced higher germination (35%) of *S. hermothica* than the other species. None of the *Desmodium* species root exudate induced germination of *O. ramosa*.

Key words: Root exudates, *Desmodium*, *Striga*, *Orobanche*, parasitic weeds

4.2.6 Germination, Attachment and Development of *Striga hermonthica* (Del.) Benth from Sudan with Host Crops and Non-host Crops

Abbasher,^{1*} A. Abbasher, Mohamed S. Zaroug,¹ Eldur B. Zahran¹, and Joachum Sauerborn²

1 Faculty of Agriculture & Natural Resources, University of Gezira.

2 Institute of Crop Production in the Tropics and Subtropics (380), University of Hohenheim, D-70599 Stuttgart, Germany

* Corresponding author, email: basherawad@yahoo.co.uk

Striga hermonthica (Del.) Benth, is a root parasitic weed that reduces the yield of sorghum, maize, pearl millet, sugarcane and rice in the semiarid tropics. Germination of *Striga* is induced by stimulants exuded by roots of hosts and non-hosts. Germination of *S. hermonthica* collected from Sudan 2004/2005, using catch and trap crops, was investigated in root chambers. *Striga* germinated with all crops tested. Beside sorghum varieties and maize, *S. hermonthica* germinated, attached and developed to complete striga plants with barley and two cultivars of wheat from Sudan. This is the first report of *S. hermonthica* parasitizing wheat and barley from Sudan. Usage of root chambers clearly proved that some leguminous crops were susceptible to *S. hermonthica*. Chickpeas (*Cicer arietinum* L.), phillipesera (*Vigna trilobata* L.) brown seed cowpea (*Vigna unguiculata* L. Walp.) and hyacinth bean (*Lablab purpureous* L.), peas (*Pisum sativum* L.), pigeon pea (*Cajanus cajana* L.) induced germination, attachment, haustoria formation and development of complete green *Striga* plants. Other leguminous crops like soybean (*Glycine max* L.), white seed cowpea (*Vigna unguiculata* L. Walp.) , fababean (*Vicia fabae* L.) and mung bean *Vigna radiata* (L.) R.

Wilczek , together with crop plants belong to the families Asteraceae and Malvaceae supported germination, attachment and formation of haustoria but no further development of *S. hermonthica* was observed, a natural brownish coloration around the contact area between the parasite haustoria and the host roots was observed. These findings confirm that *S. hermonthica* could infect a large number of new hosts including leguminous crops.

Key words: *Striga hermonthica*; germination; attachment; host range; leguminous crops.

4.2.7 Effects of powder and aqueous extracts of *Euphorbia hirta* on *Phelipanche ramosa* germination and haustorium initiation

Tilal S. Abdelhalim^{a a-d}, Babiker. A.G .T^b, Hiba A. Ali^C, Maria R. Finckh^d

^a Horticultural Research Centre, Agricultural Research Corporation (ARC), Wad Medani, Sudan. P.O.box:126

^b Plant Protection Department, College of Agriculture studies, Sudan University of Science and Technology, Khartoum North, Shambat Sudan P.O.box:71

^C Commission for Biotechnology and Genetic Engineering, National Center for Research, Khartoum, Sudan

^d Ecological Plant Protection Group. College of Organic Agricultural Sciences, University of Kassel, Witzenhuasen, Nordbahnhof Strasse, Germany, D37213

Phelipanche ramosa, a root parasitic weed, is a copious seed producer. The seeds are characterized by prolonged viability and special germination requirements. Parasitism is achieved through an orderly sequence of events comprising of seeds pre-treatment in a moist warm environment followed by germination in response to an exogenous stimulant. Subsequent to germination the radicle elongates and in response to a second host-derived stimulant a haustorium is initiated and attachment to the host root occurs. The parasite inflicts most of its damage to the host prior to emergence. Therefore it is plausible that perturbations, spatial and/or temporal, of the sequence of pre-attachment events may reduce parasitism and crop yield losses. A series of laboratory experiments was undertaken to investigate the effects of powder and aqueous extracts from *Euphorbia hirta* on germination, radicle elongation, and haustorium initiation in *P. ramosa*. *P. ramosa* seeds conditioned in water and subsequently treated with diluted *E. hirta* extract (10-25% v/v) displayed considerable germination (47-62%). Increasing extract concentration to 50% or more reduced germination in response to the synthetic germination stimulants GR24 and Nijmegen⁻¹ in a concentration dependent manner. *P. ramosa* germlings treated with diluted *Euphorbia* extract (10-75% v/v) displayed haustorium initiation comparable to the synthetic haustorium factor DMBQ at 20 μ M. *Euphorbia* extract applied during conditioning reduced haustorium initiation in a concentration dependent manner. *E. hirta* extract or air-dried powder, applied to soil, induced considerable *P. ramosa* germination. The results indicate the plausibility of using *E. hirta* air-dried powder or extract as spot treatments to induce suicidal germination of *P. ramosa*. Furthermore, the results also indicate the potential of *E. hirta* as a source of compounds that can be used as templates for synthesis of more active compounds to perturb pre-attachment stages in *P. ramosa*.

Keywords: Broomrapes; seedbank; conditioning; *Euphorbia* extract; pre-attachment stages

5.2.1 Mycotoxins produced by *Fusarium* spp. isolated from *Striga hermonthica* (Del.) Benth. in Sudan

Mohukker¹ R.I., Hetwer², U., Ahmed³, N.E., and Karlovsky², P.

1 University of Khartoum, Faculty of Science, Botany Department, P.O.Box 321, Khartoum, Sudan

2 University of Göttingen, Molecular Phytopathology and Mycotoxin Research, Grisebachstrasse 6, D-37077 Göttingen, Germany

3 Agriculture Research and Technology Corporation, P.O. Box 126, Gezira, Sudan

Three isolates of *F. solani* and one isolate of each of *F. oxysporum*, *F. nygamai*, *F. equiseti*, and *F. compactum* were fully toxicologically characterized. These *Fusaria* were isolated from naturally infected *Striga hermonthica* plants collected from sorghum cultivations in central (Gezira), eastern (Gadarif), and southeastern Sudan (Damazin). HPLC/MS or HPLC/DAD system was used for the toxicological characterization of *Fusarium* spp. using nivalenol, deoxynivalenol, 3-acetyl deoxynivalenol, 15-Acetyl deoxynivalenol, fusarenon X, T2-toxin, HT-2 toxin, diacetoxyscirpenol, zearalenone, fumonisin B (B1 and B2), enniatin B, B1 and A and fusaric acid as toxin standards. The three isolates of *F. solani* produced none of the above toxins. *Fusarium oxysporum* and *F. nygamai* produced fusaric acid. *Fusarium nygamai* also produced fumonisins B1, B2, and B3. *Fusarium equiseti* produced nivalenol, fusarenon X, and diacetoxyscirpenol. *Fusarium compactum* produced nivalenol. This is the first report of nivalenol production by a strain of *F. compactum*. Non toxin-production by the three isolates of *F. solani* and production of only fusaric acid by *F. oxysporum* make them toxicologically safe for further evaluations as biocontrol agents for the witchweed.

Keywords: Mycotoxins, *Fusarium* spp., *Striga hermonthica*, Sudan

5.2.2 *Fusarium nygamai* and *Fusarium* Abuharaz selected for biocontrol of *Striga hermonthica* (Del.) Benth in Sudan produce fumonisins B

Mohukker R.I., Hetwer, U., Ahmed, N.E., and Karlovsky, P.

Two isolates of *Fusarium* spp., *Fusarium nygamai* (FN) and *Fusarium* Abuharaz (FA) showed high efficacy in controlling *Striga hermonthica* under field conditions in the Sudan. In this study the two isolates produced several mycotoxins of fumonisin B series in rice cultures. These included fumonisins B1, B2, B3 and B5, partially hydrolyzed fumonisin derivatives PHFB1, PHFB2, PHFB4. Further derivatives FB4 and PHFB4 were detected only in FN. This is the first report on fumonisin B-series production ability by *Fusarium* Abuharaz. Detectable amounts of FB1 were found in sorghum grains harvested from fields treated with the two *Fusaria* as well as in sorghum grains harvested from untreated fields in the same area. The amount of FB1 was very low, ranging between 6 – 30 ng/g in grain from biocontrol-treated field. In the untreated fields, the amount of FB1 ranged between 5-16 ng/g. These amounts are far below the maximum values for fumonisins in maize permitted in European Communities and USA. No legal limits for sorghum have been established. The presence of genes FUM1 and FUM8 involved in fumonisin production has been detected by PCR in the DNA of both isolates. The sequences of the intergenic transcribed spacer of

ribosomal genes (ITS) of FN and FA were identical, indicated a close genetical relationship between them as well as with selected members of the *Gibberella fujikuroi* complex.

Keywords: Fumonisin, *Fusarium nygamai*, *Fusarium Abuharaz*, *Striga hermonthica*

5.2.3 Inhibition of *Striga*-seed Germination by phenazine-1-carboxylic acid and phenazine-1-carboxamide

Mohukker R.I., Hetwer, U., Ahmed, N.E., and Karlovsky, P.

Pseudomonas aeruginosa was found to be associated with a *Fusarium* sp. propagated on a sorghum seed solid medium that used *in vitro* to control *Striga*-seed germination. When both organisms were inoculated into a PDB medium, the culture media were found to contain metabolites which inhibit *Striga*-seed germination. Two compounds were purified from the culture broth and they completely inhibited *Striga*-seed germination at relatively low concentrations. Compound 1 was identified as phenazine-1-carboxamide (PCN) and compound 2 was identified as phenazine-1-carboxylic acid (PCA). Since fungi were not reported to produce such compounds, they were considered to be produced solely by the associated bacterium. Phenazine-1-carboxamide completely inhibited *Striga* seed germination at a concentration of 2.24 mM. At the same concentration phenazine-1-carboxylic acid resulted in 79.6 % inhibition of *Striga* seed germination. When this concentration was diluted 10 and 100 times respectively the *Striga* germination increased rapidly for both compounds. PCA was highly effective only at a relatively high concentration of 22.4 mM causing nearly complete inhibition of germination. This is the first report on the effect of these two compounds on *Striga* seed germination. Both compounds did not inhibit the Sorghum grain germination at all concentrations tested. However, compound 1 at the concentration 22.4 mM significantly inhibited Sorghum radicle length ($P < 0.05$) compared to the control. All concentrations of PCA had no effect of significance on sorghum radicle length ($P > 0.05$). When comparing the effect of the two phenazine compounds on seed germination of both Sorghum and *Striga*, they did affect *Striga* germination causing 100% and 79.6% inhibition at 2.24 mM for PCN and PCA respectively. At the same concentration 2.24 mM the two phenazines did not affect Sorghum grain germination or radicle length. Sorghum radicle length was only significantly affected by PCN when the concentration was 22.4 mM. At the same concentration PCA did not affect the Sorghum radicle length.

Keywords: Phenazine-1-carboxamide, phenazine-1-carboxylic acid, *Striga*-seed

5.2.4 Distribution and host range of mistletoe (*Tapinanthus globiferus*) (A. Rich.) van Tieghan) along the Blue Nile Banks in Central Sudan

Zaroug*, M. S.; Abbasher, A. A.; Zahran, E. B.

Faculty of Agriculture and Natural Resources Abu Haraz, University of Gezira

* Corresponding author, email: mszarouk@gmail.com

Mistletoes of the genus *Tapinanthus* (Loranthaceae) is a stem hemiparasite causing damage on citrus and guava trees in central Sudan. The objectives of this study are: to assess the distribution, incidence, severity and host range of the parasite. Surveys were conducted in 2008\2013 in four States along the Blue Nile banks in an area extended about 492 km. Results indicated that the parasite is widely distributed along the Blue Nile banks from Al-Rusayris (12° 21' 4" N and 34° 22' 14" E) to Hisahisa (14° 44' 47" N and 33° 17' 43" E). The highest incidence of the parasite (69%) occurred in Blue Nile State, followed by Sinar state (66.3%) with highest incidence (100%) reported in Singa Province. While Kamlin province (Northern Gezira state) and Khartoum state were seemed to be free from the parasite. The highest percentage of mistletoe infection was found on lime (*Citrus aurantifolia* Swingle) and guava (*Psidium guajava* M.) in Western and Eastern Sinar respectively, with disease severity index range between 74. %- 90. % in both localities. The parasitic weed appears to have a wide host range, attacking 22 species belonging to 14 families. The most affected trees were citrus, guava and *Ziziphus spina-chriti*.

Key words: Mistletoes, guava, lime, incidence, severity index, host range, Sudan.

5.2.5 Determination of weed flora and abundance index in New Halfa Agricultural Scheme

Mohamed ElKhawad and Abosofian S. Osman, Agricultural Research Corporation

Field survey was conducted during season 2011 to determine types of flora and weed dominance at New Halfa Scheme, which can be used as a basis for monitoring, control, as well as conservation of biological diversity of weed flora. The scheme was divided into six sectors from which a total of thirty- three fields were selected and ten quadrates (1m²) from each field were taken randomly. In each quadrate number of individual weed species were recorded. Field frequency, uniformity and mean field density were determined. In this study, thirty- five weed species belonging to nineteen families (three monocotyledonous and sixteen dicotyledonous) were recorded. *A. glaucum*, *A. ficulenus*, *A. rugosus*, *B. eruciformis*, *D. retroflexa*, *I. afrum*, *I. cordofana*, *P. niruri*, *R. minima*, *S. sesban* and *X. brasilicum* were the most dominant weed species in the scheme. High abundance index of *P. niruri* (181.58, 175.45 and 174.53) were shown at Demyat, Alwasat and Debera sectors. *S. sesban* recorded high abundance index at Alsabaat and Sasareb sectors (175.82, 166.73) while *I. cordofana* were the highest at Sheik omer sector (146.75).

Key words: New Halfa Scheme, Abundance index, *Phyllanthus niruri*

5.2.6 Critical period of weed control in direct seeded onion

Nasr Eldin Khairi Abdalla and A.G.T. Babiker

An experiment was undertaken at Gezira Research Station Farm during season 2003/04 and 2004/05 with objective to determine the critical period of weed control in direct seeded onion. The crop was either kept weed free for first 2, 4, 6, 8, 10 and 12 weeks after crop emergence (WACE) and afterwards remained weedy till harvest or remained weedy for the same period and then kept weed free throughout the season. The results showed that total number of weeds per m² in the plot kept initially weedy for the first 2 – 12 WACE were 137 – 172 and 115 – 260 plants in season 2003/04 and 2004/05, respectively. Weed ground cover and weed biomass were positively correlated with weedy period. Weed biomass was positively correlated with weed ground cover. The later was positively correlated with weed population. The number of weeds was negatively correlated with weed free period and positively correlated with weed ground cover and weed biomass. Crop growth attributes were progressively increased with weed free period and decreased with weedy period. The crop kept weedy for the first 2 – 6 WACE or weed free for 2 – 4 WACE resulted in plant height comparable to the full season weed free period. A comparable number of leaves per plant to the weed free control were attained from plots kept initially weedy for 2 – 6 WACE or remained weed free for the first 2 – 8 WACE. At harvest bulb diameter displayed consistent increase with weed free period and consistent decrease with weedy period. The crop kept weed free for more than 8 WACE or kept weedy for the first 2 – 4 WACE displayed bulb diameter comparable to the full season weed free control. Irrespective of the season, the onset of critical period of weed/crop interference started 2 WACE when 3 – 17% of the total bulb yield was lost and terminated at 10 WACE. Delaying weed removal from the onset of critical period resulted in significant reduction in bulb yield. On the other hand weed removal after termination of critical period resulted in non-significant increased in bulb yield.

Key words:Critical period, direct seeded onion, weed removal

5.2.7 Allelopathy in mesquite (*Prosopis juliflora*): A factor in invasiveness and dominance of the species

Abdalla, M. Z., Tilal Abdelhalim, Babiker A. G. T. and Fujii Y

First author: Researcher Kenana Sugar Company LTD Research and Development Department, White Nile State Sudan, Second author: Assistant professor Shambat Research Station, Agricultural Research Corporation Shambat Khartoum North Sudan. Third author: Professor College of Agriculture Studies, Sudan University of Science and Technology, Shambat Khartoum North Sudan, Fourth author: Professor Tokyo University of Agriculture and Technology, Fuchu, Tokyo Japan. Corresponding author's E-mail: agbabiker@yahoo.com

Common mesquite (*Prosopis juliflora*), a fabaceae, native to South America, was first introduced into Sudan in 1917 to curb desertification. However, the plant has spread and become a weed of national importance and a threat to biodiversity. The present investigation was undertaken at the College of Agricultural Studies, Sudan University of Science and Technology to study allelopathic potentials of mesquite, and activity and persistence of the allelochemicals in soils. In all experiments lettuce (*Lactuca sativa* L.) was used as a test plant. Powdered mesquite parts including leaves, stems, barks and pods, showed differential effects on lettuce seed germination and seedlings growth. Germination of lettuce was the least affected while the seedlings growth was negatively affected. The radicle was more sensitive

Third Conference of Pests Management in Sudan February 3-4, 2014 CPRC-ARC, Wad

to the toxins than the hypocotyl. Mesquite pods were the most suppressive followed in descending order by bark, leaves and stems. Toxins were active through soil and their persistence progressively declined with time. The results suggest that mesquite parts contain water-soluble allelochemicals and that allelopathy may contribute, considerably, to the invasive nature of the plant and its dominance.

Keywords: Allelochemicals, biodiversity, desert encroachment, Fabaceae, germination