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Effects of Nitrogen Fertilization, Datura and Jatropha Aqueous Extracts on *Striga hermonthica* Incidence on Wheat *(Triticum eastivum L.)*

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Abstract

Pots experiment was conducted during the two consecutive winter seasons 2019/20 and 2020/21 at the demonstration farm, Collage of Agricultural studies (CAS), Shambat, University of Science and Technology, Khartoum Bahri, Khartoum state, Sudan (Latitude15° 40` N and Longitude 32° 23` E,) to evaluate the efficacy of nitrogen fertilization and two botanical water extracts (Datura and Jatropha) and Nitrogen, each one alone on Striga hermonthica incidence and growth and yield of wheat. All treatments significantly reduced number of Striga emergence, Striga shoot fresh and dry weights (g). Striga infestation significantly reduced wheat grain yield by 63.14%. Nitrogen in the form of urea at 80 lb/fed., significantly increased wheat grain yield (kg/fed.,) by 196.15 %. Among all treatments Nitrogen at 80 lb/fed., was the best treatment which achieved highest wheat grain yield (kg/fed,) and gave comparable grain yield (kg/fed,) to that obtained by Striga free control.

Keywords: Combination, incidence, grain, and reduced

تأثيرات التسميد النيتروجيني والمستخلصات المائية للداتورة والجاتروفا علي البودا في القمح

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المستخلص

أجريت التجربة خلال موسمين شتويين متعاقبين للعامين 2019/ 20م 21/2020م بالمزرعة التجريبية، كلية الدراساتالزراعية، شمبات، جامعة السودان للعلوم والتكنولوجيا، الخرطوم بحري، ولاية الخرطوم، السودان (خطي عرض 15 و °40وخطي طول 23 و °40 لتقييم كفاءة المستخلصات المائية لنباتي (الداتورة والجاتروفا)، والنيتروجين، كل منهامنفرداً علي نمو طفيل البودا وتأثيره علي نمو وانتاجية القمح. كل المعاملات قللت معنوياً أعداد البودا المنبثقة، الوزن الرطب والوزن الجاف (جم) للمجموع الخضري للبودا. اصابة القمح بالبودا قللت معنوياً انتاجية الحبوب بنسبة63.14%. النيتروجين في صورة يوريا بمعدل 80 رطل للفدان زاد معنوياً انتاجية حبوب القمح (كجم/فدان) بنسبة 196.15%. من بين المعاملات كلها النيتروجين بمعدل 80 رطل للفدان كان أحسن معاملة وحقق أعلي إنتاجية حبوب للقمح (كجم/فدان) وأعطي إنتاجية حبوب مشابهة لتلك التي تم الحصول عليها في الشاهد الخالي من البودا.

كلمات مفتاحية: دمج، اصابة، حبة، وقلل

Introduction

Wheat (*Triticum aestivm* L.) belongs to the Family Poaceae. It is the most important cereal crop in the world. At present it is cultivation extends word wide. It is considered as the third most-produced cereal after maize and rice (FAO, 1992). Its grains are a major source of energy, protein, and dietary fiber in human nutrition. Wheat supplies much of the world's food supply and dietary protein (FAO, 1992). It has become the most important source of carbohydrate in the majority of countries in the temperate zone. Its straw is used as feed for livestock in underdeveloped countries (FAO, 2003 and FAO, 1992).

In Sudan, wheat is becoming the staple food of both urban and rural populations. It considered the second food grain in the Sudan after sorghum. It is an important strategic crop in terms of food security. Wheat is planted in the fertile alluvial soils of the Nile in the Northern and River Nile States where winter is relatively longer and cooler (Mukhtar *et al*., 2013). Since 1960, wheat production has moved south wards and the crop is now cultivated in the Geziera, White Nile, Gedarif, Kassala and Darfur states (FAO, 2003). The recent construction of the Merowe Dam expand areas under wheat cultivation in the two Northern States.

Parasitic weeds are a major threat today in agriculture and provide an intriguing case of pathogenesis between species. Almost all crops species are potential hosts for parasitic weeds, but severe infestation and outbreak are usually restricted to certain host-pathogen combinations (Ejeta 2007; Ejeta *et al*., 1992). *Striga hermonthica* parasitic weed belongs to the Orobanchaceae Family infects economically important cereals crops, such as Sorghum, wheat, maize, pearl millet, and rice, causes huge damage to world agriculture, especially in sub-saharan Africa (Ejeta, 2007). Research in Africa on the control of *Striga* has been going on for 70 years (Ahmed *et al*., 2001). *Striga spp* are obligate hemi-parasitic weeds attach to the root of their host to obtain water, nutrients

and carbohydrate (Fasil, 2002). The seed of *S. hermonthica* is small dust like (Parker and Riches, 1993). *Striga* is completely dependent on the host for its survival, and its life cycle is closely linked with that of the host plant (Haussmann *et al.*, 2000). They have an after-ripening requirement and cannot germinate in the season in which they are produced (Fasil, 2002). Many potential control methods were developed against the parasite problem such as physical, cultural, chemical, and biological (Joel, 2002).

Botanical extracts of some plants will be a promising source of pest control compounds such as *Jatropha curcas* (Osman, 2019). The current study design to explore new environmental friendly pesticide to control weeds that can replace the highly toxic chemicals. The plant *Datura stramonium* L. belongs to Family Solanaceae, it is used in traditional medicine worldwide, practically in African countries such as Sudan and Libya (Shayoub *et al*., 2013; Ahmed, 2007; Elkamali and Khalid, 1996). *Jatropha curcas* L. belongs to Family Euphorbiaceae, that is native to the American tropics, most likely Mexico and Central America (Osman, 2019). It is cultivated in tropical and subtropical regions around the world (Yonli *et al*. (2010). In Sudan can be found in many regions like the Blue Nile, South Kordufan, Kassala, South Darfur States and other Stats (Adam, 2016).

Generally there is lack information on effects of nitrogen fertilizer and medicinal botanical extracts on *striga*, thus, this research was designed to investigate the effects of nitrogen fertilizer and two medicinal botanical aqueous extracts (Datura and Jatropha) on *Striga hermonthica* incidence on wheat. We have been following this approach to exploit of the effectiveness of the interaction of these control methods in a sound manner to fulfill the following objectives:

1- To determine the effect of different concentrations of aqueous extracts of Datura, Jatropha on *Striga hermonthica* and growth and yield of wheat.
2- To determine effects of different doses of Nitrogen on *Striga* and growth and yield of wheat.

Materials and Methods

A pot experiment was conducted during the two consecutive winter seasons 2019/20and 2020/21 at the demonstration farm, Collage of Agricultural Studies, Shambat, Sudan University of Science and Technology, Khartoum Bahri Locality, Khartoum State, Sudan, Latitude15° 40` N and Longitude 32° 23` E (Babiker *et al*., 2013) to evaluate the efficacy of water extracts of Datura leaves, Jatropha seeds and Nitrogen fertilizer In the form of urea, on *striga hermonthica* incidence and wheat growth and yield.

Datura leaves were collected from Shambat, Khartoum Bahri and Jatropha seeds were collected from National Tree Seeds Center. The plants materials were washed and dried at room temperature and were separately ground into fine powder (<1mm) and stored until use.

Plant aqueous extracts at 10% concentrations were obtained by soaking at room temperature. Ten grams of powdered part of plant material were placed in a 250 ml glass beaker with 100 ml of sterile distill water for 24 hours and each suspension was then filtered through two tools, the first (nylon cloth) served to move big debris and the second (filter paper) to set an homogeneous

solution. Other concentrations (5% and 2.5%) were obtained by dilution 10% concentration as described by Yonli *et al.* (2010).

Wheat cultivar (Asareca-w2) grains were obtained from Elobied Research Station, Agricultural Research Corporation. The wheat grains were placed in six beakers contained Datura and Jatropha water extracts each at 2.5%, 5% and 10%. beakers were placed at room temperature for eight hours before planting. The seeds of controls were placed in beaker containing sterile distilled water.

The inoculated soil with *Striga* seeds at 20mg was added to the pots except *Striga* free control and thoroughly mixed by hand.

The wheat grains which were treated by *Datura* and *Jatropha* aqueous extracts were sown on 23th December in 2 cm soil depth, five /hole, later thinned to two plants per hole three weeks after sowing (WAC). Nitrogen fertilizer in the form of urea was applied at 40, 80 and 120 Ibs/fed. They applied as two equal split doses, one at thinning and the second at when plant at knee high. *Striga* Infested and *Striga* free controls were included for comparison. The treatments arranged in a randomized complete block design (RCBD).

The effects of the treatments were assessed by counting number of *Striga* shoots at 6, 10 and 14 WAS. At harvest *Striga* plants collected from each treatment were weighted to determine fresh weight, and then air-dried for dry weight. At flowering, two plants of wheat were taken to determine growth parameters including plant height (cm), shoot fresh weight/plant (g), shoot dry weight/plant (g), number of leaves/plant and days to 50% flowering. At harvest 1000 grain weight (g) and grain yield (kg/fed.) were recorded.

Data collected and measured in this experiment were subjected to analysis of variance (ANOVA) for each season separately and then combined as described by Gomez and Gomez (1984). The analysis carried out using the statistical analysis system (SAS) computer package for SAS Institute Inc., 1990, to detect significant effects among the treatments and populations compared.

Results and Discussion

Striga count made at 6, 10 and 14 (WAS) showed that, the number of *Striga* emergence increased with increasing of the number of weeks (Table 1). Statistical analysis showed significant differences among all treatments. At 6, 10 and 16 WAS, all treatments significantly reduced number of *Striga* emergence as compared to Striga infested control treatment (Table 1). Similar results were found by Osman (2019).The treatments which achieved lowest number of *Striga* were the highest (120 lb/fed.), and medium (80 lb/fed) of nitrogen and they gave comparable number of *Striga* shoots to Striga free control. Possible reason for this might be the presence of allele pathic effects of concentrations, and that might be attributed to the hormone –like properties of allelo-chemicals of plants extracts such as choline and flavonoids (Osman, 2019).

All treatments significantly reduced *Striga* shoot fresh and dry weights (g) compared to the Striga infested control treatment (Table 2). The highest rates of Datura and Jatropha, and the medium rate of nitrogen gave highest *Striga* shoot fresh and dry weights (g) comparable to that obtained by control treatments (Table 2). Possible reason for this could be due to *Striga* seeds cannot germinate

in the absence of a chemical stimulant, because nitrogen decreases stimulant production by the host plant Osman, 2019). This result is in agreement with that obtained by Lagoke and Isah (2010) who reported that, Nitrogen reduced the severity of *S. hermonthica*.

All treatments significantly increased wheat shoot fresh (g)/plant and shoot dry weight (g)/ plant as compared to the *Striga* infested control treatment (Table 3). The high concentration of Datura (10%) and the medium rate of Nitrogen (40 lb/fed.) were the best treatments which achieved highest shoot fresh (g)/plant and shoot dry weight (g)/ plant and were comparable to that obtained by *Striga* free control treatment. Similar findings were obtained by Asifullah *et al*. (2017).

All treatments significantly increased number of tillers/plant as compared to the *Striga* infested control treatment. The highest concentration of Datura (10%) and the medium rate of nitrogen (40 lb/fed.) were the best treatments which achieved highest number of tillers/plant. The attained number of tillers per plant were comparable to that obtained by *Striga* free control treatment.

The high rate of Datura (10%), medium (5%) and high rates (10%) of Jatropha and the low and medium rates of nitrogen (40 and 80 lb/fed.) significantly increased plant height (cm) as compared to the Striga infested control treatment (Table 3). The highest concentration of Jatropha (10%) and the medium rate of nitrogen (80 lb/fed.) resulted in highest plant height (cm) and were comparable to that obtained by *Striga* free control treatment(Table 3).

All treatments did not significantly increased 1000 grain weight (g) as compared to the *Striga* infested control treatment (Table 4).

Combined analysis of both winter seasons indicated that, *Striga* significantly reduced wheat grain yield by 63.14 compared to *Striga* free control. Similar result was obtained by Ejeta (2007) who reported that, parasitic plants are acquired the ability to obtain nutrition from host plants and have adapted to prefer less fertile soil and consequently cause considerably loss to the crop.

Combined analysis of both winter seasons reported that, all treatments except (Datura 2.5%, Jatropha 2.5% and nitrogen at 120 lb/fed.) significantly increased wheat grain yield as compared to the *Striga* infested control treatment (Table 4). Nitrogen at 80 lb/fed., significantly increased wheat grain yield (kg/fed.) by 196.15 % as compared to the *Striga* infested control treatment.

Among all treatments nitrogen at 80 lb/fed., was the best treatment which achieved highest wheat grain yield (kg/fed,) and gave comparable grain yield (kg/fed,) to that obtained by *Striga* free control (Table 4). The grain yield (kg/fed.) increased when the level of nitrogen increased until certain level. These results might be due to the increase up of grain yield attributing characters and nutrient uptake of the crop under these levels as well as reduced *Striga* infestation at high application levels (Osman, 2019). These findings are in agreement with those obtained by Hugar*et al*. (2010) who reported that, the grain yield increased when the level of nitrogen increased. High levels of *Striga* infestation are often associated with low soil fertility (Oswald, 2005). Several reports have shown that nitrogen at high rates suppresses Striga infestation, while at low rates it enhance emergence of the parasite (Hugar *et al*., (2010). Also these results are in line with those obtained by Oswald (2005) who indicated that, low levels of *Striga* infestation are often associated with high soil fertility.

Table 1: Effect of Datura, Jatropha aqueous extracts and nitrogen fertilization on *Striga* emergence (plants/pot) in both winter seasons combined

Treatments	Number of Striga (plants/pot)		
	6 WAS	10 WAS	14 WAS
Datura 2.5%	1.67 b	2.67 b	3.33 a
Datura 5%	1.33 b	2.00 b	2.33 b
Datura 10%	0.67 c	1.00 c	1.33 c
Jatropha 2.5%	1.67 b	2.33 b	2.33 b
Jatropha 5%	1.67 b	2.00 b	2.00 b
Jatropha 10%	1.00 bc	1.33 bc	1.33 c
Nitrogen 40 lb/fed.	1.67 b	1.67 bc	1.67b c
Nitrogen 80 lb/fed.	0.33 c	0.33 c	0.67 c
Nitrogen 120 lb/fed.	1.00 bc	1.33 bc	1.33 c
Striga free control	0.33 c	0.33 c	0.33 c
Striga control	3.33 a	4.33 a	4.67 a
CV	6.36	4.89	6.06
SE±	0.10	0.14	0.25

WAS= weeks after sowing.

Means followed by the same letter (s) within each column do not differ significantly at 5% level of probability according to DMRT

Table 2: Effects of Datura, Jatropha aqueous extracts and nitrogen fertilization on *Striga* shoot fresh andshoot dry weights (g)in both winter seasons combined

Treatments	Striga shoot fresh weight (g)	Striga shoot dry weight (g)
Datura 2.5%	1.67 b	1.00 b
Datura 5%	1.67 b	1.00 b
Datura 10%	1.00 bc	0.67 c
Jatropha 2.5%	2.00 b	1.33 b
Jatropha 5%	1.67 b	1.00 b
Jatropha 10%	1.33 bc	0.67 c
Nitrogen 40 lb/fed.	1.67 b	1.33 b
Nitrogen 80 lb/fed.	0.33 c	0.17 c
Nitrogen 120 lb/fed.	1.17 b	1.00 b
Striga free control	0.33 c	0.18 c
Striga control	5.00 a	3.95 a
CV	17.09	20.19
SE±	0.15	0.14

Means followed by the same letter (s) within each column do not differ significantly at 5% level of probability according to DMRT

Table3: Effects of Datura, Jatropha aqueous extracts and nitrogen fertilization on wheat growth parameters in both winter seasons combined

Treatments	Shoot fresh weight (g)/ plant	Shoot dry weight (g)/ plant	Number of tillers/ plant	Plant height (cm)
Datura 2.5%	5.00 c	2.33 c	3.67 c	30.67 e
Datura 5%	7.00 b	4.33 b	4..00 c	36.83 d
Datura 10%	10.33 a	7.00 a	6.67 a	55.17 b
Jatropha 2.5%	5.00 c	2.67 c	2.00 d	35.10 d
Jatropha 5%	5.67 b	4.33 b	4.00 c	46.17 c
Jatropha 10%	6.67 b	4.67 b	5.67 b	58.50 ab
Nitroge40 lb/fed.	5.67 c	2.33 c	3.67 c	44.00 c
Nitrogen 80 lb/fed.	10.67 a	7.67 a	6.67 a	59.83 a
Nitrogen 120 lb/fed	5.33 c	2.67 c	5.33 b	33.33 de
Striga free control	10.33 a	7.33 a	7.00 a	60.33 a
Striga control	4.67 d	2.00 d	1.67 d	35.67 d
CV	20.80	0.42	34.24	4.80
SE±	0.91	15.68	0.91	1.25

Means followed by the same letter (s) within each column do not differ significantly at 5% level of probability according to DMRT

Table 4: Effects of Datura, Jatropha aqueous extracts and nitrogen fertilization on wheat yield in both winter seasons combined

Treatments	1000 grain weight (g)	Wheat grain yield (kg/fed)
Datura 2.5%	37.67 a	5.67 de
Datura 5%	37.33 a	6.63 cd
Datura 10%	48.00 a	7.50 c
Jatropha 2.5%	36. 67 a	4.67 e
Jatropha 5%	38.33 a	6.47 cd
Jatropha 10%	47.33 a	10.13 b
Nitrogen 40 lb/fed.	39. 33 a	9.50 b
Nitrogen 80 lb/fed.	48.67 a	13.83 a
Nitrogen 120 lb/fed.	37.00	5.90 cde
Striga free control	40. 00 a	12.67 a
Striga control	36.33 a	4.67 e
CV	9.48	12.86
SE±	0.62	0.55

Means followed by the same letter (s) within each column do not differ significantly at 5% level of probability according to DMRT

Conclusions:

1- Datura and Jatropha aqueous extracts reduced *Striga* emergence and *Striga* fresh and dry weights.

2- Nitrogen in the form of urea at tested rates effectively suppressed *Striga* emergence.

3- Effectiveness of Datura, Jatropha and nitrogen levels increased by increasing concentrations, or rates.

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