Critical period of weed interference in irrigated common bean (*Phaseolus vulgaris* L.) in Dongola area

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ABSTRACT: This study was conducted at the Faculty of Agricultural Sciences farm, University of Dongola, El Selaim, during 2010/2011 and 2011/2012 winter seasons to investigate common bean (*Phaseolus vulgaris* L.) yield loss due to weeds and identify the critical period for weed control. Common bean was sown on 23 November in both seasons. A set of weeding regimes comprising of 12 treatments was arranged in randomized complete block design with four replicates. The crop was kept weed-free for 2, 4, 6, 8 or 10 weeks after sowing and afterward remained weedy till harvest or kept weedy for the same periods and then remained weed- free till harvest. Weed free and weedy treatments, till harvest, were included as controls. Combined analysis of both seasons indicated that unrestricted weed growth significantly reduced common bean grain yield by 57.98% compared to the weed free treatment. Yield decreased as the duration of the weed infestation increased. Plant height was significantly reduced by 45.95% under full season weedy conditions. The same trend was observed for number of leaves/plant, shoot fresh weight/plant and shoot dry weight/plant. The critical period of weed competition was found to be between 4-6 weeks after planting.

KEYWORDS: *Critical period, weed competition, weeding regimes*

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is an important food legume in Sudan. It is the second important food legume after faba bean in the Northern State. It is planted in the fertile strip of alluvial soils of the Nile valley, on both banks of the Nile river, from Khartoum to Wadi Halfa. The crop is an important source of protein for a major sector of the population, particularly, in urban areas. Furthermore, it is of significant economic importance to farmers [1,2]. Weeds constitute one of the main constraints in legumes production in Sudan. They reduce yield and indirectly interfere with the use of land and water resources and adversely affect human welfare[3]. Unrestricted weed growth promotes soil degradation in cultivated lands and reduces yield of arable crops by 50-100%[4]. The magnitude of yield losses due to weeds in common bean in Dongola area has not been estimated. However, yield losses of up to 80% in similar crops such as faba bean, chickpea and lentil were reported [5]. The traditional method for controlling weeds in legumes in Northern Sudan is late hand-weeding which is carried out, voluntarily, by farmers to collect fodder for livestock. Hand weeding is labour intensive, tedious, laborious, time consuming, and is therefore expensive when done by hired labour. The yield losses are mainly due to delayed weeding or insufficient weed control [5, 6].

The critical period for weed interference is defined as the period in the crop growth cycle during which weeds must be controlled to prevent unacceptable yield losses[7]. Weeds removal during this period is mandatory to optimize weed control. It enables decision making on the need for and timing of efficient weed Control [8]. Generally, the critical period for weed interference is influenced by many factors such as weed species, the environment, and

plant density, time of competition, soil fertility and crop cultivar [7, 8]. The critical delay in weeding for most crops was found to be 4-6 weeks and when weeding starts at 6 weeks after sowing, yield losses amount to 35-40 %[9]. Information on the competitive ability of weeds in common bean is lacking in Sudan. This study was, therefore, conducted to investigate yield loss due to weeds and identify the critical period for weed interference.

MATERIALS and METHODS

An experiment was conducted at the Faculty of Agricultural Sciences farm, University of Dongola, El Selaim, Northern State, Sudan. The State is located within latitude 16° and 22° N, and longitude 20° and 32° E. The area is a true desert with extremely high temperatures and radiation in summer, low temperature in winter, scarce rainfall and high wind speed. The mean maximum and minimum temperatures are 36.8 and 19.5°C, respectively. The climate is hyper arid with a vapour pressure of only 10.8 mb and a relative humidity less than 20% [10].

The experimental site was disc ploughed, harrowed, leveled, and divided into plots in each season. Plot size was 3×2 m. Each plot consisted of six rows, each two meters long. Common bean, variety Balady, was sown on 23 November during 2010/2011 and 2011/2012 seasons at Dongola, Northern State, Sudan. Three seeds/hole were planted in rows 60 cm apart and 20 cm between holes, on flat plots. Seedlings were thinned to two plants/hole two weeks after planting resulting in approximately 84000 plants/feddan. Weeding regimes, comprising of 12 treatments, were arranged in randomized complete block design with four replicates. The crop was kept weed-free for 2, 4, 6, 8 or 10 weeks after crop sowing and later remained weedy till harvest or kept weedy for the same periods and then maintained weed- free till harvest in both seasons. Weed-free and weedy treatments till harvest were included as controls. In the weed- free treatment, weeds were removed by repeated hand weeding to keep the crop free from weeds up to harvest. However, in the weedy treatment, weeds were left to grow, unrestrictedly, with the crop until harvest. Nitrogen fertilizer, in the form of urea, was applied at 43 kg /ha immediately after thinning before the third irrigation. Irrigation was applied at 10-15 days interval depending on temperature and other environmental conditions. Cultural practices were carried as recommended by the Agricultural Research Corporation recommendations [5, 10]. At eight weeks after sowing ten plants were randomly selected from the four inner rows in each plot. Plant height, number of leaves/plant, shoots fresh weight/plant and shoot dry weight/plant was measured. At harvest, pods from ten randomly selected plants were collected and mean number of pods/plant, mean number of seeds/pod were recorded. Pods were air dried, threshed and 100 seed weight determined. The harvested area (m^2) from each plot was air dried and threshed in bulk, then weighted and the total grain yield (kg/ha) was calculated. The data was subjected to analysis of variance and means were separated using the Duncan's Multiple Range Test.

RESULTS and DISCUSSION

The weed flora in the experimental site consisted of grassy and broad-leaved weeds. The dominant weed species were *Cynodon dactylon* (L.) pers., *Sorghum arundinaceum*. (Dew.) Stapl, *Tribulus terrestris* L., *Amaranthus viridis* L., *Sonchus oleraceus* L., *Eruca sativa* Mill., *Amaranthus graecizans* L., *Euphorbia aegyptiaca* Boiss., *Solanum nigrum* L. and *Trigonella hamosa* L. Combined analysis of both seasons indicated that unrestricted weed growth accounted for 57.98% loss in common bean yield, compared with the weed-free out (Table 1). Similar results were reported by several workers [5,11,12] that, reductions in yield of common beans due to weeds ranged from 24-74%. Findings reported by Mohamed *et al*., [13] and Khogali *et al*., [5] indicated that yield losses due to weeds in similar crops such as faba bean, chickpea and lentil are more than 50%. Losses due to weeds ware a result of competition for water, nutrients and light and because of the low competitive ability of the legume crops during the early stages of growth. Early removal of weeds will, therefore, enable the crop to maximize the use of the available resources. Common bean grain yield decreased as the duration of weed infestation increased. This finding is in line with that of reported by Worwick and Black [16]who showed that, crop grain yield reduction by weeds was directly related to the duration of weed interference. The reduction in common bean grain yield due to weeds interference was mainly through reduction in number of seeds/pod and 100 seed weight (Table 1 and 2). The critical period of weed interference in common bean was between 4 and 6 weeks after crop planting (Table 1). The critical period for weed competition in most crops was reported to be between 4 and 6 weeks after sowing [9]. Dawood (14) and Mukhtar [15] showed that, the fourth week after sowing is the most critical period of weed control in faba bean. This difference in the critical period is expected, because the critical period for weed control is influenced by several factors including weed species, density or ground cover by weeds, the environment, plant density, time of weed competition, soil fertility and crop cultivar [4, 7]. Common bean Growth parameters were also adversely affected by weed competition. Plant height was significantly reduced by 45.95% under full season weed competition. The same trend was also observed for number of leaves/plant, shoot fresh weight/plant and shoot dry weight/plant (Table 2). It is evident that a weed-free period starting from the 4th to the 6th week after sowing is necessary to provide high grain yield. To attain weed-free environment in common bean, pre or post-emergence herbicides, mechanical and haweeding should be timed and adjusted to the critical period of weed competition only. In this, way use of persistent soil acting herbicides could be avoided and weed control treatments minimized.

CONCLUSIONS

Combined analysis of the data for the two seasons indicated that unrestricted weed growth was accounted for 57.98% loss in common bean yield. Grain yield decreased as the duration of weed infestation increased. The reduction in yield due to weeds

interference was mainly through reduction in number of seeds/pod and 100 seed weight. The critical period of weed competition was between 4 and 6 weeks after crop planting

Table 1: Combined influence of duration of weed interference on grain yield and yield components during both winter seasons,

Treatments	No. of pods/plant	No. of seeds/pod	100 seed weight (g)	Grain yield (kg/ha)
Weed-free for 2 weeks	8.40a	3.28cd	20.00bc	789.21e
Weed-free for 4 weeks	9.30a	4.00bc	20.40bc	1026.02d
Weed-free for 6 weeks	9.70a	4.62ab	21.15bc	1022.69d
Weed-free for 8 weeks	9.50a	5.10a	21.10b	1140.73c
Weed-free for 10 weeks	9.10a	5.20a	20.90bc	1331.13b
Weedy for 2 weeks	7.90a	4.50ab	20.10bc	661.16f
Weedy for 4 weeks	7.50a	3.50bcd	19.80bc	609.28g
Weedy for 6 weeks	7.20a	3.30cd	19.10bc	593.1h
Weedy for 8 weeks	7.10a	3.20cd	20.10bc	583.34h
Weedy for 10 weeks	6.40a	2.90d	17.90c	581.43h
Full season weed-free control	9.20a	5.20a	29.50a	1404.2a
Full season weedy control	6.60a	3.20cd	18.40bc	247.90h
C. V%	25.50	15.20	10.20	3.90
S. E.±	02.78	0.29	1.15	7.21

-Means with the same letters in the same column are not significantly different at $p \leq 0.05$ level of probability according to DMRT.

Table 2: Combined influence of duration of weed interference on common bean growth parameters during both winter season.

Treatments	Plant height (cm)	No. of leaves/plant	Shoot fresh wt (g)/plant	Shoot dry wt (g)/plant
Weed-free for 2 weeks	50.30c	62.00bc	31cd	7.30bc
Weed-free for 4 weeks	61.20b	66.10abc	34.20bc	6.80c
Weed-free for 6 weeks	61.10b	68.50ab	42ab	8.10abc
Weed-free for 8 weeks	65.70b	69.40ab	47.10a	8.70abc
Weed-free for 10 weeks	79.20a	71.90ab	49.90a	9.90ab
Weedy for 2 weeks	39.90e	57.80cd	24.00d	6.40c
Weedy for 4 weeks	45.00cde	54.00de	22.80d	6.40c
Weedy for 6 weeks	47.10cde	48.40de	20.00d	6.30c
Weedy for 8 weeks	40.00e	48.20de	22.40d	6.60c
Weedy for 10 weeks	48.90cd	47.40de	21.20d	7.00c
Full season weed-free control	80.30a	76.10a	45.70a	10.00a
Full season weedy control	43.40de	43.90e	21.70d	6.30c
C. V%	26.00	33.80	31.80	35.00
S. E.±	30.70	43.25	33.50	2.35

-- Means with the same letters in the same column are not significantly different at 0.05 level of probability according to DMRT.

REFERENCES

1. Babiker, A. G. T., Ahmed, E. A.,Dawoud, D. A. and Abdella, N. K. (2007). *Orobanche* species in Sudan: History, distribution and management. *Sudan Journal of Agricultural Research* **10**: 107-114.

2. Elballa, M. M. A., El-amin, A. H .B.,Elamin, E.A. and Elsheikh, E. A. E. (2004). Interactive effects of cultivars, foliar application of micronutrients and *Rhizobium* inoculation on snap bean (*Phaseolus vulgaris* L.) performance. *University of Khartoum Journal of Agricultural Sciences* **12**: 321-332

3. Hamada, A. A.; Eltahir, S. A. and Mukhtar, A. M. (2009). Weed survey on maize (*Zea mays* L.) in Dongola area, Northern State, Sudan. *Sudan Journal of Agricultural Research* **13**, 57-66.

.
4.Mukhtar, A. M., Eltahir, S. A., Siraj O. M.and Hamada, A. A. (2007). Effect of weeds on growth and yield of maize (*Zea mays* L) in Northern State, Sudan. *Sudan Journal of Agricultural Research*, **8:**1-7.

5. Khogali, I. I.; Elsadig, S. M. and Salah, E. E. (2007). Chemical weed control in irrigated common bean (*Phaseolus vulgaris* L.) in Northern Sudan. *Sudan Journal of Agric -ultural Research*, **8**: 17-21.

6. Mohammed, E. S. and Abdalla, H. N. (1997). Chemical weed control in garlic (*Allium sativum* L.). *University of Khartoum Journal of Agricultural Sciences* **5**: 40-51.

7.Mahgoub, B. M. (2002). *Determination of Critical Period for Weed Competition in maize (Zea mays L.) as Influenced by Nitrogen Fertilizer uptake and Chemical Weed Control.* Ph. D Thesis, University of Khartoum, Khartoum, Sudan.

8. Dogan, M. N; Unay, A.; Boz, O. and Albay, F. (2004). Determination of optimum weed control timing in maize (*Zea mays* L.). *Turk Journal of Agricultural Research* 28: 349-354.

9.Hamdoun, A. M. and El Tigani, K. B. (1977). Weed control problems in the Sudan, *PANS*, **23**: 190-194.

10. Mukhtar, A. M. O. (2006). *Weeds in Maize* (*Zea Mays L.*): *Importance and Control with special reference to the North State of Sudan*. Ph. D Thesis. Sudan University of Science and Technology, Khartoum, Sudan.

11. Wolley, B. L. (1989). *Integrated Weed Management in White Beans* (*Phaseolus vulgaris* L.). M.Sc. Thesis. University Grueph, Guelp, Ontario.

12. Malik, V. S.; Claremce J. S. and To 6 M. (1993). Interaction of white bean (*Phaseolus vulgaris* L.) cultivars, row spacing and seeding density with annual weeds. *Weed Science*, **41**: 62-68.

13. Mohamed, E. S; Nourai, A. H; Mohamed, G. E; Mohamed, M. I. and Saxena, M. C. (1997). Weeds and weed management in irrigated lentil in Northern Sudan. *Weed Research*, **27**: 211-218.

14. Dawood, D. A. (1989). Effect of crop weed competition on faba bean production in Selaim basin (North Sudan). *Annual Report, Hudeiba Research Station,Dongola Resea-rch Station, Shendi Research Station,* Agricultural Research Corporation (ARC). Sudan. PP:120-124.

15. Mukhtar, A. M. O. (1998). *Effect of Some Soil-applied Herbicides on Growth, Yield and Weed Control in Faba Bean (Vicia faba L.)*. M.Sc. Thesis.University of Khartoum, Khartoum, Sudan.

16- Warwick, S. I. and Black, L. D. (1988). The biology of Canadian weeds *Abutilon theophrastican*. *Plant Science*, **68**: 1069 – 1085.