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INFLUENCE OF PLANT POPULATION AND WEED MANAGEMENT PERIODS ON CROP-WEED COMPETITION OF GROUNDNUT

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ABSTRACT

Population density and weed competition in crops constitute the main limiting factors for groundnut crop yields in Bangladesh. An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during April to August, 2008 to investigate the optimum population density and the most appropriate weeding period of groundnut. Two plant population viz. i) 200,000 (D_1) and ii) 400,000 plants ha^{-1} (D_2) and seven weed competition periods viz. i) No weed competition (WC_0), ii) weed competition for the first 25 DAS and thereafter weed free (WC_1), iii) weed competition for the first 40 DAS and thereafter weed free (WC_2), iv) weed competition for the first 55 DAS and thereafter weed free (WC_3), v) weed competition for the first 70 DAS and thereafter weed free (WC_4), vi) weed competition for the first 85 DAS and thereafter weed free (WC_5) and vii) weed competition up to harvesting (WC_6) were studied. It was evident from the result that yield and yield contributing all characters except number of primary branches, total pods and mature pods, were increased at a plant density of 400000 plants ha^{-1}. Weed competition period for the first 40 DAS and thereafter weed free up to crop harvest emerged out positive responses on yield and yield contributing characters.

Keywords: plant population, weed competition period, groundnut

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the most important oil crops and cultivated around the world. It stands first in terms of yield and third, next to mustard and sesame in respect of total oil seed crops area and production in Bangladesh (BBS, 2011). It is highly nutritious crop and contains about 48% oil, 25-30% protein, 20% carbohydrate, B and E vitamins, higher quantity of linoleic acid (Khaleq, 1986). It enriches the soil by fixing atmospheric nitrogen about 40-80 $kgha^{-1}$ (Islam and Noor, 1982). It is reported that oil seed crops produce 0.17 million tons of edible oil in every year as against the total requirement of 1.36 million tons for a population of 156 million in Bangladesh (Anon., 2009). Therefore, the country has to increase its production by vertically to satisfy its internal demand by the adoption of appropriate improved production technologies. Among them, optimum plant density and weed competition periods are most important factors for crop production as they give the best yield while saving cost of growers (Laurence, 1983). Optimum plant population of groundnut per unit area gave positive response to higher yield (Patel *et al.*, 1985).

During crop growth, weeds are a permanent constraint to crop productivity and economic returns in agriculture. Several studies have indicated that unweeded treatment caused a decrease on yield of groundnut by 46-55% (Sibuga *et al.*, 1989). The critical period of weed interference is defined as the crop growth period when it must be kept weed-free to prevent yield loss caused by weed interference (Van Acker *et al.*, 1993). However, studies illustrate that the critical period of weed interference can vary depending on several factors including crop and weed characteristics and environmental conditions (Knezevic *et al.*, 2002). The critical period of grass weed control was found to be from 4.3 to 9 week after planting (WAP), whereas the critical period of broadleaf weed control was from 2.6 to 8 WAP (Everman *et al.*, 2008). Mohamed *et al.* (1997) reported that the critical period of weed interference in the related legume crop, lentil (*Lens culinaris* Med.), was between 2 and 4 weeks after sowing and at a cooler location

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with a longer growing season this period was between 4 and 6 weeks after sowing. Increasing the duration of weed free periods linearly increased the yield of unshelled nuts and that's why yield loss should be kept to a minimum level by controlling weeds at proper time (N'Zala *et al.*, 2000 and Everman *et al.*, 2008). Therefore, the present piece of research work was designed to investigate the potential plant population and optimum weed competition periods to increase the yield of groundnut.

MATERIALS AND METHODS

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during April to August, 2008. The experimental site belongs to the Sonatola Soil Series of Old Brahamaputra Floodplain characterized by Non-calcarious Dark Grey Floodplain Soil (FAO, 1988). The land was medium high with sandy-loam texture having pH 5.9. The variety ACC-12, popularly known as 'Jhinga Badam' in Bangladesh was used as the test crop. The experiment consisted of two plant population viz. i) 200,000 plants ha^{-1} spaced at 30 cm x 16.7 cm (D_1) and ii) 400,000 plants ha^{-1} spaced at 30 cm x 8.35 cm (D_2) and seven weed competition periods: i) No weed competition i.e. weed free throughout the growth period (WC_0), ii) weed competition for the first 25 DAS and thereafter weed free (WC_1), iii) weed competition for the first 40 DAS and thereafter weed free (WC_2), iv) weed competition for the first 55 DAS and thereafter weed free (WC_3), v) weed competition for the first 70 DAS and thereafter weed free (WC_4), vi) weed competition for the first 85 DAS and thereafter weed free (WC_5), and vii) weed competition up to harvest (WC_6). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications and unit plot size was 4m x 2.5m. The land was prepared by ploughing followed by laddering to bring a good tilth. The crop was fertilized with 75-200-85-110 kg of urea, triple super phosphate, muriate of potash and gypsum ha^{-1}, respectively. One-half of total urea and entire amount of other fertilizers were applied at final land preparation. The remaining amount of urea was applied at 40 DAS as top dressing. Before sowing the pods were sun dried and shelling was done manually with much care so that the 'niacin' content of the seed remained intact. Two shelled seeds were sown per hill according to treatment specification. The crop was thinned to maintain a desired population density at 35 days after emergence. Weeding was done as per treatment specification. After the specific weed competition periods, weeds were uprooted by hand with 'nirani' and thereafter the crop was kept weed free up to harvest. Intercultural operations were done as necessary. The sample plants uprooted at maturity stage for recording data on different plant characteristics. The pods were separated from the plants manually and weights were taken. Both pod and haulm were sun dried and recorded yield. The recorded data were analysed using Analysis of Variance with the help of computer package MSTAT. The mean differences among the treatments were adjusted with Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effects of plant population

Plant height was significantly affected by plant density of groundnut and the highest plant height (85.1 cm) was found at a density of 400000 plants ha^{-1} compared to 200000 plants ha^{-1} (Table 1). Higher plant density, probably, did not offer enough space for profuse branching and the plants showed marked elongation of the main shoot. This finding is in agreement with the findings of Salem *et al.* (1984). Kvien *et al.* (1983) also reported that plant height decreased from 63 to 28 cm as area $plant^{-1}$ increased from 140 to 4500 cm^2. Number of primary branches, total pods, mature pods, one seeded pods, two seeded pods, three seeded pods and four seeded pods $plant^{-1}$ were significantly increased when plant density was 200000 plant compared to 400000 plants ha^{-1} (Table 1 and Fig. 1). Production of increased number of all those traits at lower plant density were probably due to availability of more space, nutrients, air, water and light to the plant, which helped to accomplish photosynthetic properly and supply adequately to the sink, thus those yield components were attributed to the higher magnitude.

Table 1. Effect of plant density on the yield contributing characters of groundnut

Treatment (Plant density)	Plant height (cm)	Primary branches plant^{-1}	Total pods plant^{-1}	One seeded pods plant^{-1}	Two seeded pods plant^{-1}	Three seeded pods plant^{-1}	Four seeded pods plant^{-1}	Weight of 100 seed (g)	Shelling percent-age	Pod yield (tha^{-1})	Dry haulm yield (tha^{-1})	Harvest index (%)
200000 (D_1)	90.3b	6.3a	15.1a	1.6a	3.0a	3.3a	0.8a	47.10	70.87b	2.10b	6.03b	25.3a
400000 (D_2)	85.1a	5.1b	11.9b	0.9b	2.1b	2.1b	0.4b	47.76	72.58a	2.67a	8.31a	23.9b
								NS				

Means in a column having the same letter do not differ significantly at $p <\_ 0.01$
NS = Not significantly different at $p <\_ 0.05$

On the other hand, plant density of 400000 plants ha^{-1} got relatively less space, air, water and light and ultimately produced less number of primary branches, total pods, mature pods, one seeded pods, two seeded pods, three seeded pods and four seeded pods plan $^{-1}$. Similar results were also observed in groundnut by Rweyemanu and Mushi (1988), Mamin (1989), Hamid and Chowdhury (1989), and Nakagawa *et al.* (1996). Conversely, Rweyemanu and Mushi (1988) reported that seed pods^{-1} did not differ significantly by the plant population. Immature and undeveloped pods plant^{-1} and 100 pods and grains weight were not influenced statistically by plant density but higher plant density produced comparatively higher number of undeveloped pods plant^{-1} and 100 pods and grains weight than lower plant density (Table 1 and Fig. 1). Competition from weeds, the crop plants in the high density also

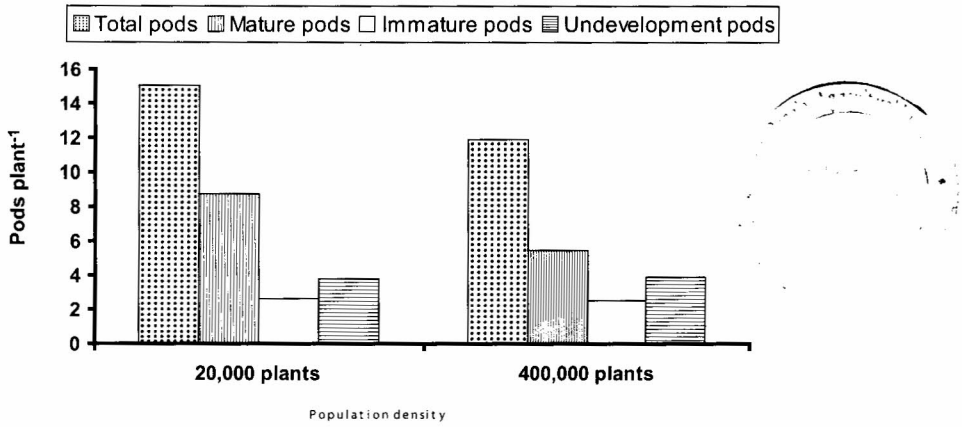

Fig. 1. Effect of plant population on the total pods, mature pods, immature pods and undeveloped pods plant^{-1} of groundnut

competed among themselves for air, nutrients, water, space, light and due to competition among the plants for growth factors pods though formed, failed to develop into mature pods and remained undeveloped pods. It was also probably due to lower number of plants ha^{-1} producing higher number of branches and total pods and always encouraged to produce more branches and pods than that of higher number of plants ha^{-1}. So, photosynthetic product could not be well distributed and ultimately gave lower weight of 100 pods and grains. This finding is in conformity with the findings of Laurence (1983) and Kvien *et al.* (1988) who reported that the variation in plant population per unit area did not significantly influence the 100 pods and grains weight. Shelling percentage and dry haulm yield significantly influenced by plant density and it was observed that higher plant population (D_2) gave higher shelling percentage and dry haulm yield than lower

plant population (D_1) (Table 1). These findings agree with Laurence (1983), Kumar (1993) and Nakagawa *et al.* (1996) who observed that higher plant density caused an increase in shelling percentage and dry haulm yield. But incase of shelling percentage, opposite results were reported by Anon (1988), who did not find any significant effect with the variation of plant density. Pod yield was influenced statistically by plant density and it was observed that pod yield markedly increased when density was 400,000 plants ha^{-1} compared 200,000 plants ha^{-1} (Fig.2). There are reports that increase in plant density increases the pod yield in groundnut (Kumar, 1993 and Nakagawa *et al.*, 1996). Higher plant population did not always encourage producing more primary branches and total pods $plant^{-1}$ than lower plant population, ultimately photosynthetic products distributed well and accumulated in the pod. So, shelling percentage and dry haulm yield and also pod yield were high at high plant density. Higher plant density in combination with higher weight of 100 pods at D_2 resulted in higher yield of pod compared to D_1. Harvest index was significantly influenced by plant density and it was higher at D_1. This finding is in agreement with that of Mamin (1989) who reported that harvest index was higher at wider inter- and intra-row spacing and gradually decreased with increasing inter-and intra-row spacing.

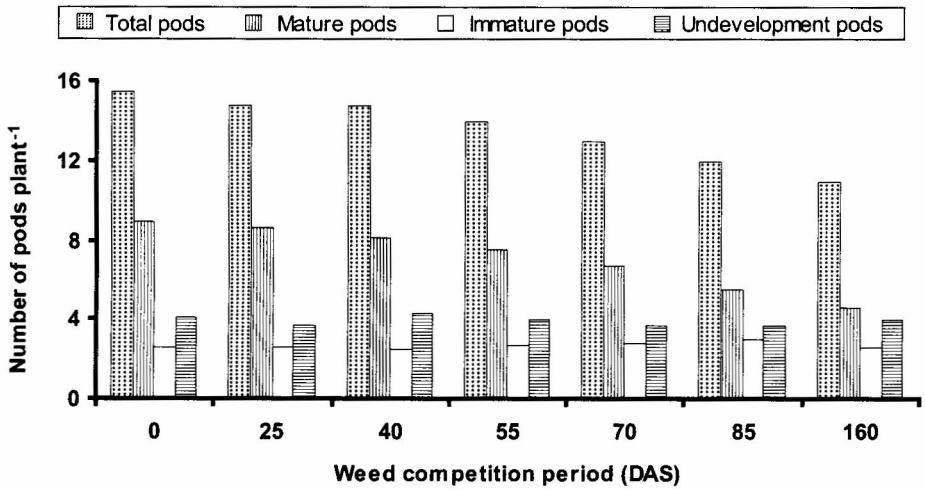

Fig. 2. Effect of weed competition period on the total pods, mature pods, immature pods and undeveloped pods plant-1 of groundnut

Effects of weed competition period

Weed competition periods significantly favored the plant height and the tallest plants were produced in the treatment where weeds were allowed to grow till 40 DAS and thereafter kept weed free up to crop harvest (WC_3). Maintenance of weed competition period up to 25 DAS (WC_2) and no weed competition through the crop growth period (WC_0) behaved in the similar manner as that of weed competition up to 40 DAS in respect of plant height (Table 2). A linear trend of increase in the plant height was found the decrease in weed competition which was prominent up to 40 DAS. The shortest plants were obtained when weeds competed with the crop for its total growth period (WC_6). Primary branches $plant^{-1}$ decreased significantly with the increase of weed competition which was prominently evident from weed competition up to 40 DAS onwards and the lowest was obtained when weeds competed with the crop up to harvest (WC_6). Weeds competed with the crop for space, light, moisture and nutrients and thus the growth of crop was severely affected which was exhibited in the decreased number of primary branches. Hamada (1989) observed that the continuous presence of weeds reduced the number of branches $plant^{-1}$. Number of total

pods and mature pods plant^{-1} was found to decrease significantly with the increase of weed competition compared to weed free treatments (Fig. 2). The exuberant growth of weeds competed severely with the crop plants thereby reducing the number of total pods and mature pods is in agreement with results reported by Hamad *et al.* (1988) and Santi-Promkum (1988) in groundnut. The effect of weed competition period was not found to be significant in respect of producing immature pods, undeveloped pods, 100 seed weight and shelling percentage (Fig. 2 and Table 2). Anon (1988) noted that weed free treatments had no effect on shelling percentage and

Table 2. Effect of weed competition periods on the yield contributing characters in groundnut

Weed competition Period (DAS)	Plant height (cm)	Primary branches plant^{-1}	Total Pods plant^{-1}	One seeded pods plant^{-1}	Two seeded pods plant^{-1}	Three seeded pods plant^{-1}	Four seeded pods plant^{-1}	Weight of 100 pod (g)	Weight of 100 seed (g)	Shelling percentage	Dry haulm yield (tha^{-1})	Harvest index (%)
WC_0	85.8a	6.4a	15.4a	1.4a	3.1a	3.5a	0.9a	122.8ab	48.79	71.50	8.5a	25.9a
WC_1	85.4a	6.4a	14.7b	1.3abc	3.1a	3.4a	0.8b	126.4a	46.07	71.87	8.3b	26.7a
WC_2	85.9a	5.7bc	14.7b	1.6a	2.9ab	2.8bc	0.8b	127.6a	48.92	71.89	8.0c	26.2a
WC_3	83.7b	5.9ab	13.9c	1.4abc	2.6bc	2.9b	0.5c	126.9a	48.14	72.13	8.0c	23.8b
WC_4	82.8c	5.5bc	12.9d	1.3abc	2.5c	2.5c	0.4d	117.9ab	47.80	71.29	7.1d	23.2b
WC_5	79.6d	5.3c	11.9e	1.1bc	1.9d	2.1d	0.3d	120.4ab	48.05	71.70	5.8e	23.7b
WC_6	75.9e	4.5d	10.9f	0.9c	1.8d	1.6e	0.2e	114.0b	44.24	71.67	4.6f	23.1b
									NS	NS		

Means in a column having the same letter do not differ significantly at $p <\_ 0.01$
NS = Not significantly different at $p <\_ 0.05$

number of pods plant^{-1} but seed size responded well. Increasing the duration of weed competition period, caused a progressive decrease in the one, two, three and four seeded pods plants^{-1} (Table 2). Santi-Promkum (1988) and Hamad *et al.* (1988) also reported that number seeds pod^{-1} and seed weight were not different by weed infestation levels. Pod yield was significantly affected by weed competition and it was found to decrease notably with the extension of weed competition period which became more pronounced at 55 DAS to onward (Fig. 3).

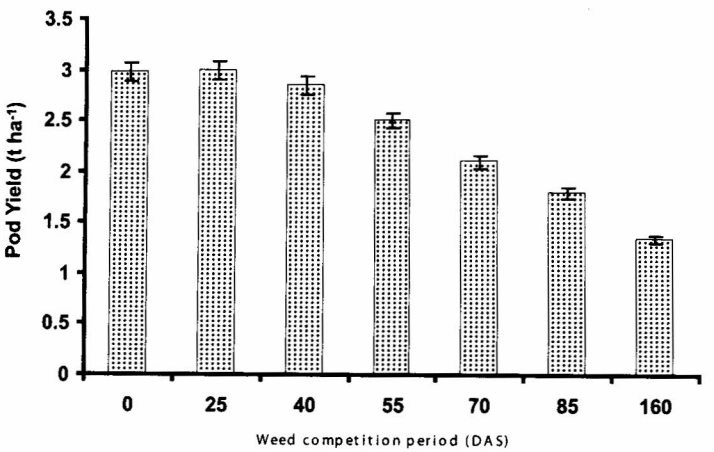

Fig. 3. Effect of weed competition period on the yield of groundnut

The highest pod yield was found at WC_1. Critical period of crop-weed period competition appeared to lie between 2 to 6 weeks after sowing. This was in conformity with the findings of Singh *et al.* (1985) who found

Plant density and weed competition period emerged out as two important determinants of yield and yield contributing traits of groundnut. From the findings of the experiment it can be concluded that weed growth in groundnut can be checked to a great extent with a density of 400000 plants ha^{-1}. To obtain better biological and pod yield the groundnut preferably grown at a density of 400000 plants ha^{-1} maintaining weed free condition up to 40 days after sowing.

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