Weed Pressure on Growth and Yield of Groundnut (Arachis hypogaea L.) in Meghalaya, India

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ABSTRACT

In two consecutive seasons a field experiment was conducted in randomised block design replicated thrice with twelve treatments including two sets of treatments, viz. initial weedy and initial weed free treatment with 15 days interval up to harvesting. They are weeds up to 15, 30, 45, 60, 75 days after emergence (DAE), weedy treatment and weed free up to 15, 30, 45, 60, 75, weed free treatment to assess the effect of weed flora on growth and yield of groundnut. The results show that the growth parameters like Plant height (59.80, 50.56 and 55.18 cm), Dry matter (28.12, 24.49 and 26.3 g/plant), LAI (2.56, 2.47, 2.51) and yield attributes of groundnut were significantly with increasing of initial weed free treatments and highest number of pods per plant (22.20, 16.52 and 18.80), number of seeds per pod (1.90, 1.80 and 1.85), seed index (24.01, 23.52 and 23.59), seed yield (1.35, 0.94 and 1.15 t/ha) and STOVER yield (3.87, 3.37 and 3.62 t/ha) and Harvest index (50.24, 21.84 and 23.86%) were found in weed free check. Similarly, lowest was found in weedy check in both season.

Key words: Season, Weeds, Growth, Days after emergence, Yield

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Introduction

Groundnut, known as king of oilseeds grown in India and is one of the most important food as well as cash crop of our country. It is gaining importance due to its contents namely, 48-50% of oil and 26-28% of protein. It’s photo insensitive, mid-season drought tolerant and has wide range of adaptability to various agro-climatic situations. Globally, Groundnut is grown on an area of 24.38 million ha, 40.78 million metric tons of production with 1.67 metric tons productivity during 2016 (FAS/USDA, 2016). In India, it is cultivated over an area of 4.50 million hectares, with a production of 4.70 million metric tons. However, its productivity is low (1.04 metric tons per hectares) when compared to worlds’ average productivity (FAS/USDA, 2016).

During crop growth, many weeds cause losses in groundnut yield by competing for water, space, light and nutrients with crop. It is necessary to maintain the crops in a weed-free condition during the critical period for crop-weed competition to maintain high yields.
(Islam et al., 2016). So if it is weed-free at initial stage of crop growth, then the weeds that come up later are also suppressed, resulting in lower weed density leading to vigorous growth of the crop. In rice field, weeds especially barnyard grass at later stage competes for light and getting higher light use efficiency as well as shades the crop and reduces the quality and quantity of light received by rice plant as compare to initial stage of crop growth (Concenco et al., 2009). Under consideration of these things, going to evaluate what are the effects of weeds and their density on growth and yield of groundnut in Meghalaya.

Materials and Methods

The experiment was conducted at experimental farm of the College of Postgraduate Studies (CAU), Umiam, Meghalaya, India in both Kharif and Rabi seasons of the year 2016-17. The experimental site was located at 091°54.72’ E longitude and 25°40.886’ N latitude and at an altitude of 950 m above the mean sea level (MSL). The soil of the experimental site is sandy clay loam in texture. pH (4.9), Organic carbon (0.77%), NPKS (282.24, 13.04, 241.98, 1.6 kg/ha). The experiment was conducted in a randomized block design, replicated thrice with twelve treatments, viz. weeds until 15 DAE, weeds until 30 DAE, weeds until 45 DAE, weeds until 60 DAE, weeds until 75 DAE, weedy treatment and weed free until 15 DAE, weed free until 30 DAE, weed free until 45 DAE, weed free until 60 DAE, weed free until 75 DAE, weed free treatment. ‘ICGS-76’ is the variety of Groundnut was sown in June 23 (Kharif), and November 22 (Rabi) during both the experimental seasons with plant spacing of 40 x 10 cm² on flat beds. Recommended doses of N, P and K = 25:60:60 NPK kg/ha (Full doses N, P and K were applied at the time of sowing) Standard agronomic practices were followed during crop growth period and crop was harvested after physiological maturity. Randomly, ten plants were selected from each plot and regular biometric observations were taken for growth and yield of crop at DAE to harvest with an interval of 15 days.

The analysis of data was done using the Fisher’s method of analysis of variance technique as described by Gomez and Gomez (1984). The differences of means were identified by Duncan’s univariate test at P ≥ 0.05.

Results and Discussion

The most dominated weed floras in both experimental seasons was listed in Table 1. Grassy weeds are most dominated weed spices in both seasons of groundnut.

Plant height

The results of plant height data was shown in Table 2. Different weedy and weed free treatment was significantly affected on plant height. The highest plant height was found in season long weed free treatment with 68.15, 57.76 and 62.95 in Kharif, Rabi and Pooled, respectively. The competitive ability of the groundnut increased with the increasing space occupied by the plants as well as weeds. Weeds grow faster than groundnut at initial stage and cover the plant canopy and the lower space reduces the resource availability by the individual plant, this might be reducing the height of groundnut plant. However, the height of weeds increased with respect to its dominance over the crop. Thus, cumulative effect decreased the height of the groundnut plant. Hakim et al., (2013) observed that the plant height of rice was significantly influenced by weed competition period, increased the length of weed interference and caused shortest plant. The taller plants were found in weed free check while the weedy check treatment resulted in shorter plants.
Dry matter accumulation (g/plant)

The dry matter accumulation in the plant increased with progression of growth period of the groundnut during both seasons of the experimentation. Further, the dry matter accumulation of Kharif season was higher than the Rabi irrespective of its growth stages.

Weed free check treatment accumulated higher dry matter with 28.12, 24.49 and 26.3 g/plant at harvest in Kharif, Rabi and Pooled, respectively than the other periods of weed free and weedy plots. However, the lowest production was associated with the weedy plots. Due to accumulation of large quantity of dry matter by plants with better leaf canopy development, which made the plants to utilize the available resources more efficiently for photosynthesis and translocation to different parts, which intern resulted in higher dry matter production. Karkanis et al., (2012) reported that the dry weight of parsley reduced with increasing duration of weed pressure, confirming the high sensitivity of the parsley crop to weed interference.

Leaf area index

The leaf area index of groundnut was significantly affected by increasing the length of weed interference period and, conversely favourably influenced by the increasing span of weed free period, up to 75 DAE during both Kharif and Rabi season. Further, at 75 DAE the greater leaf area index was observed in season long weed free treatment with 2.56, 2.47, 2.51 in Kharif, Rabi and Pooled, respectively. However, the lowest leaf area index was observed in weedy treatment.

Table 1. Weed composition of Groundnut in two season of the experiment

| Sl. No | Scientific name                | Common name              | Kharif | Rabi |
|--------|--------------------------------|--------------------------|--------|------|
| 1      | Ageratum conyzoides            | Nilam (Goat weed)        | +      | +    |
| 2      | Ageratum houstonianum          | Goat weed                | +      | +    |
| 3      | Amaranthus spp.                | Pigweed                  | -      | +    |
| 4      | Ambrosia artemisiifolia        | Stick weed               | +      | +    |
| 5      | Bidens pilosa                  | Spanish needle           | +      | +    |
| 6      | Borreria hispida               | Thaarthaval              | +      | +    |
| 7      | Borreria latifolia             | Broadleaf button weed    | +      | +    |
| 8      | Celosia argentina              | White cock's comb        | -      | +    |
| 9      | Commelina bengalensis          | Benghal dayflower        | +      | -    |
| 10     | Cynodon dactylon               | Bermuda grass            | +      | +    |
| 11     | Cyperus iria                   | Yellow nut sedge         | +      | -    |
| 12     | Cyperus rotundus               | Purple nut sedge         | +      | +    |
| 13     | Dactyloctenium aegyptium       | Crow foot grass          | -      | +    |
| 14     | Digitaria ciliaris             | Southern crabgrass       | +      | +    |
| 15     | Digitaria marginata            | Finger grass             | +      | -    |
| 16     | Digitaria sanginalis           | Crabgrass                | +      | +    |
| 17     | Echinochloa colonum            | Swanki                   | +      | +    |
| 18     | Echinochloa crusgalli          | Barnyard grass           | +      | +    |
| 19     | Eleusine indica                | Goose grass              | +      | +    |
| 20     | Galinsoga parviflora           | Potato weed              | +      | +    |
| 21     | Mimosa pudica                  | touch me not             | +      | +    |
| 22     | Panicum psilopodium            | Barefoot panicgrass      | +      | -    |
| 23     | Panicum trypheron              | Panic grass              | +      | -    |
| 24     | Spermotica latifolia           | False button weed        | +      | +    |

* weed present and * weed missing
**Table 2** Effect of different weedy and weed free periods on groundnut Plant height, Dry matter content (at harvest) and Leaf area index (at 75 DAE)

| Treatments          | Plant height (cm) | Plant dry matter (g) | LAI |
|---------------------|-------------------|----------------------|-----|
|                     | Kharif Rabi Pooled | Kharif Rabi Pooled  | Kharif Rabi Pooled |
| Weeds until 15 days | 60.08abc 50.81ab 55.44b | 20.83b 19.11c 19.97de | 2.42bc 1.58de 2.00cde |
| Weeds until 30 days | 58.98abc 50.07ab 54.53b | 17.78bc 18.20cd 17.99e | 2.35c 1.56de 1.96cde |
| Weeds until 45 days | 57.05abc 48.36ab 52.71b | 16.56cd 13.06f 14.81f | 2.35c 1.44e 1.89de |
| Weeds until 60 days | 56.21abc 47.56ab 51.89bc | 15.53cd 11.29f 13.41fg | 2.18d 1.44e 1.81e |
| Weeds until 75 days | 54.90bc 46.04ab 50.47bc | 13.77de 12.18f 12.98fg | 2.17d 1.43e 1.80e |
| Weed free until 15 days | 49.68c 41.57b 45.63c | 11.02e 11.63f 11.32g | 2.12d 1.38e 1.75e |
| Weed free until 30 days | 57.16abc 48.24ab 52.70b | 25.10a 15.64e 20.37de | 2.48ab 1.75cd 2.11bcd |
| Weed free until 45 days | 58.42abc 49.58ab 54.00b | 25.53a 18.59cd 22.06bcd | 2.48ab 1.91bc 2.20bc |
| Weed free until 60 days | 59.58abc 50.32ab 54.95b | 26.25a 16.70de 21.48cd | 2.49ab 2.05b 2.27ab |
| Weed free until 75 days | 59.80abc 50.56ab 55.18b | 26.52a 21.14b 23.83abc | 2.52ab 2.51a 2.51a |
| Weed Free plot       | 62.08ab 52.95ab 57.51ab | 26.77a 22.81ab 24.79ab | 2.53a 2.44a 2.48a |
| LSD (p=0.05)         | 10.59 10.08 5.19 | 3.41 1.96 1.40 | 0.09 0.26 0.10 |

*Figures not sharing the same letters in the same column differs significantly at p<0.05

**Table 3** Effect of different weedy and weed free periods on groundnut yield components

| Treatments          | Number of pods per plant | Number of seeds per pod | Seed index (g) |
|---------------------|--------------------------|-------------------------|---------------|
|                     | Kharif Rabi Pooled       | Kharif Rabi Pooled      | Kharif Rabi Pooled |
| Weeds until 15 days | 6.20f 12.65c 14.37bc     | 1.87a 1.80a 1.85a       | 23.67a 23.52a 23.59a |
| Weeds until 30 days | 14.63b 11.23d 12.80d     | 1.73ab 1.78ab 1.82ab    | 21.80abc 21.79abc 21.80bc |
| Weeds until 45 days | 13.07c 10.49e 11.72e     | 1.37bcd 1.57ef 1.64ef   | 20.83bcd 20.64bcd 20.74cd |
| Weeds until 60 days | 11.77d 8.46g 9.99f       | 1.43bcd 1.68bcde 1.73cd | 20.17cde 20.02cd 20.09def |
| Weeds until 75 days | 9.47e 7.94g 9.18g        | 1.23cd 1.61def 1.65ef   | 19.52de 18.84de 19.18ef |
| Weed free until 15 days | 8.50e 6.99h 8.17h     | 1.03d 1.46g 1.50g       | 19.03e 18.77de 18.90f |
| Weed free until 30 days | 8.40e 7.34h 8.29h     | 1.20cd 1.54fg 1.58f     | 18.20e 17.04e 17.62g |
| Weed free until 45 days | 10.87d 9.19f 10.57f   | 1.40bde 1.59de 1.63ef   | 20.00cde 19.20d 19.60def |
| Weed free until 60 days | 12.97c 11.36d 12.81d   | 1.50abc 1.64cdef 1.69de | 20.87bcd 19.97cd 20.42de |
| Weed free until 75 days | 14.27b 12.78c 14.24c   | 1.57abc 1.69bcd 1.74cd | 23.13ab 22.18ab 22.65ab |
| Weed Free plot       | 15.10b 13.52b 15.06b 1.73ab 1.73abc 1.77bc | 23.87a 23.09a 23.48a |
| LSD (p=0.05)         | 1.18 0.59 0.54 0.38 0.1 0.05 2.2 1.76 1.00 |

*Figures not sharing the same letters in the same column differs significantly at p<0.05*
Table 4 Effect of weeds on seed and stover yield and harvest index

| Treatments                  | Seed yield (t/ha) |            | Stover yield (t/ha) |            | HI (%) |
|-----------------------------|-------------------|------------|---------------------|------------|--------|
|                             | Kharif | Rabi | Pooled | Kharif | Rabi | Pooled | Kharif | Rabi | Pooled |
| Weeds until 15 days         | 1.30b   | 0.88b | 1.09b   | 3.62a   | 3.15c | 3.39a   | 48.11d | 21.84cd | 24.11bc |
| Weeds until 30 days         | 1.12d   | 0.78d | 0.95d   | 3.05a   | 2.65f | 2.85a   | 46.83e | 22.72a | 24.81a |
| Weeds until 45 days         | 0.98e   | 0.68e | 0.83e   | 2.98a   | 2.60g | 2.79a   | 43.84g | 20.76e | 22.73e |
| Weeds until 60 days         | 0.86fg  | 0.60fg | 0.73fg | 2.64a | 2.30i | 2.47a | 44.91fg | 20.69e | 22.63e |
| Weeds until 75 days         | 0.85g   | 0.59g | 0.72fg  | 2.64a   | 2.29i | 2.46a   | 41.93h | 20.60e | 22.53e |
| Weedy plot                  | 0.82h   | 0.52i | 0.67h   | 2.54a   | 2.21j | 2.38a   | 51.34a | 18.94g | 21.63f |
| Weed free until 15 days     | 0.83h   | 0.56h | 0.70gh  | 2.56a   | 2.23j | 2.39a   | 45.52ef | 20.22e | 22.30e |
| Weed free until 30 days     | 0.88f   | 0.62f | 0.75f   | 2.90a   | 2.52h | 2.71a   | 46.48e | 19.64f | 21.52f |
| Weed free until 45 days     | 1.13d   | 0.77d | 0.95d   | 3.25a   | 2.83e | 3.04a   | 48.66cd | 21.40d | 23.55d |
| Weed free until 60 days     | 1.19c   | 0.83c | 1.01c   | 3.35a   | 2.92d | 3.13a   | 49.50bc | 22.15bc | 24.20bc |
| Weed free until 75 days     | 1.35a   | 0.94a | 1.14a   | 3.73a   | 3.25b | 3.49a   | 49.71bc | 22.40ab | 24.48ab |
| Weed Free plot              | 1.35a   | 0.94a | 1.15a   | 3.87a   | 3.37a | 3.62a   | 50.24ab | 21.84cd | 23.86cd |
| LSD (p=0.05)                | 0.03    | 0.02  | 0.01    | NS      | 0.04  | NS      | 1.27    | 0.51   | 0.28   |

*Figures not sharing the same letters in the same column differ significantly at p<0.05
Weed floras in Kharif and Rabi season

The natural weed community was composed of 23 and 19 different species during 2016-17 in Kharif and Rabi, respectively. However, during both seasons, dominant weed species were very similar (Table 1).

Yield component and yields of groundnut

Results of number of pods per plant, number of seeds per plant and seed index were shown in Table 3. Both weedy and weed free treatments are shows significant effect on yield components of groundnut. Increasing weed free periods increases the yield components. The highest number of pods per plant with 22.20, 16.52 and 18.80 in Kharif, Rabi and Pooled was found in weed free up to crop harvest in both season and lowest was in season long weedy treatment. Similarly, in Kharif the number of seeds per pod (1.90) and seed index (24.01) were highest in season long weed free treatment but the highest value of seeds pod\(^{-1}\) (1.80 and 1.85) and seed index (23.52 and 23.59) in Rabi and Pooled, respectively data shows in weeds until 15 DAE. However lowest value was found in season long weedy treatment of both season. Due to less competition within the plants, high light use efficiency, maximum leaf area and less weed pressure leads to reduced weed competition with allelopathic effect on crop in initial weed free treatments. The weeds interference duration increases with crop yield component and yield will reduce drastically. Either of situations i.e. weeds free for longer or weedy for shorter periods gave better groundnut yields in all seasons it corroborates with the findings of Bhalerao et al., (2011) were reported that the maximum value of yield attributes, viz. total number of developed pods, hundred pod and hundred kernel, test weight, shelling percentage and volume weight were observed in weed free treatment. Similarly, Olayinka and Etejere (2015) lowest yield components and yield were recorded in weedy check. Singh et al., (2016) their results showed, that the yield attributes and grain yield declined with the increased duration of crop-weed interference period and increased with long weed free durations in spring maize. The results of seed yield, stover yield and harvest index were influences significantly. Further the Table 4 reviled that Kharif season getting maximum seed and stover yield and harvest index. In Kharif, Rabi and Pooled data highest value of seed yield (1.35, 0.94 and 1.15 t/ha), stover yield (3.87, 3.37 and 3.62 t/ha) and Harvest index (50.24, 21.84 and 23.86%) were found in season long weed free treatment and lowest was in season long weedy plot.

Increased weeds biomass accumulation with the increasing length of weed interference period might also be a probable source of yield reduction in groundnut. The results supported the opinion of Singh and Joshi (1993), where higher pod yield is attributed to better N accumulation, higher dry matter and CGR. Weed competition throughout the crop duration resulted in 100% yield loss in both rice cultivars compared to weed-free conditions, in which yield was 6.39-6.80 t/ha for cultivar PR 114 and 6.49-6.87 t/ha for PR 115 (Singh et al., 2014). Mandal et al., (2006) reported that weed free from 7 or 14 DAS shows significantly higher yield. On the contrary weed free after 28 DAS onwards did not increase the yield significantly over weedy check. Hamzei et al., (2007) reported that different weed interference durations and interaction of cultivar year affected significantly the grain, oil, and biological yield, but not the percentage of oil. The highest harvest index was achieved in weed control up to 10 days after emergence in maize. In case of faba bean grain yield and yield contributing traits were significantly affected by weed competition. Weed-crop competition may end from 45 days. Grain yield losses due to uncontrolled weed growth throughout the crop cycle were 46%. At the same time, plant height, numbers of pods per plant, numbers of seeds per pod and 1000 seed weight were significantly decreased due to weeds (Kavurmaci et al., 2010).

The highest growth, yield component and yield of groundnut were found in Kharif season
followed by *Rabi* season. Similarly, highest value were found in season long weed free treatment and lowest were found in season long weedy treatment. Generally the weeds were compete more at initial stage of crop growth because of initially crops grows slower in growth and weeds are taking advantage to utilise resources efficiently. Later stage of weeds are suppressed by crop due to smothering effect so early stage weed management is advisable for getting better yield of groundnut.

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