INTEGRATED WEED MANAGEMENT FOR IRRIGATED GROUNDNUT

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Abstract

Field experiment was conducted during *Kharif* season at B. Mutlur, Annamalai University to find out the effective integrated weed control method for irrigated groundnut. Results indicated that among off season land management practices soil solarization had significant effect on weeds, growth parameters and pod yield of groundnut. In weed control practices, metolachlor + hand weeding registered the higher pod yield compared to other treatment. The combination of off season land management practices and weed control measures recorded significant values on weed density, weed dry weight, growth and yield components of groundnut. Interactions of off season land management practiced and weed control measures resulted in effective control of weeds and registered high cost benefit ratio.

Keywords: Soil solarization, glyphosate, metolachlor, intercrops, weed management, weed parameter, growth components, pod yield.

Introduction

Groundnut, a legume crop is considered a potential commercial crop too in semiarid and tropical region, owing to its low productivity due to several factors. Weeds are one of the most important biological constraints limited for groundnut productivity. Uncontrolled weeds may develop strong competitiveness,(Chaudhari *et al*.,2007) these weeds can cause yield reduction up to 70% due to invasion of wide range of weed flora in the initial growth period due to its slow growth, often create too much crop weed competition (Paulo *et al* 2001) Groundnut yield decreased as weed interference interval increased (Everman *et al*. 2008). Weeds not only compete with crops for the resources like nutrients, moisture, light and space and interfer with pegging, pod development resulted in yield reduction, reduced harvesting efficiency and crop quality, frequent and heavy rainfall, unavailability of labour at critical period of competition and its high costs coupled with unfavourable soil physical conditions for intercultural operations make the chemical weed control a suitable option (Murthy,2000) But at present, the prohibitive cost, unavailability of herbicide residues, their environmental hazards and establishment of the resistant species and biotypes are major constraints in the adoption of herbicides alone as a regular practice (Kumar *et al* 2004). These facts necessitate the use of herbicide in integration with other practices like off season land management, soil solarization, intercropping methods to manage the weeds on effective, economical and ecological viable basis. Soil solarization is a non-hazardous to user as well as environment. It is a method of hydrothermal disinfection accomplished by covering moist soil with transparent polyethylene sheet during hot summer months (Bhatt *et al* 2008) Growing intercrops offers dependable return than sole cropping, suppresses weed competition, infestation of pests and diseases, provides a good soil management condition(Satishkumar *et al* 2007). Taking this into account, the present experiments were carried out to find out the effective integrated weed control method for groundnut.

Materials and Methods

Field trials were carried out at farmer's field B.Muttlur near Annamalai University, Chidambaram Taluk, Tamilnadu during *Kharif* season to assess the off season land management practices along with cultural and chemical methods. The experimental site is located at 11º24ºN latitudes and 79º41ºE. The soil

of the location field was sandy loam in texture having pH of 6.6, low in available nitrogen, medium available phosphorus and high in available potassium.

The experiments were laid out in split-plot design with main plot treatments consists of M_1-fallow land, M_2-glyphosate spray, M_3-summer ploughing and M_4-soil solarization and the sub plot comprised of S_1-unweeded control, S_2-Two hand weeding, S_3-Metolachlor @1.5kg ai ha^{-1}, S_4-Metolachlor @ 1.5 kg ai ha^{-1} + hand weeding on 30 DAS, S_5-Metolachlor @ 1.5 kg ai ha^{-1} + blackgram intercropping at 4:1ratio, S_6-Metolachlor @ 1.5 kg ai ha^{-1} + hand weeding + blackgram intercropping at 4:1 ratio. All the treatment were replicated thrice.

The groundnut VRI 2 seeds were sown in lines at 30cm spacing in between rows and 10cm between the plants. Intercrop blackgram seeds were sown in 4:1 ratio with groundnut. One row of intercrop was sown in between four rows of groundnut as additive series. An intra row spacing of 10cm for blackgram was adopted. A uniform fertilizer dose of 17kgN, 34kg P_2O_5 and 54kg K_2O and no additional dose of fertilizer was applied for intercrops.

The field was divided into four strips during off season (April to June). One strip was left out as a fallow without-any disturbance. In another strip glyphosate was sprayed twice before taking up sowing when the growth of weeds were at flowering or full blooming stage. Spraying was repeated once again after a fortnight. Another strip summer plouging was done immediately after the receipt of summer showers during the months of April-May. In another strip soil solarization was taken up by spreading polyethylene sheet on soil after a light irrigation was given to increase the soil temperature and to hasten the weed seed germination. Soil temperature were recorded by using soil thermometer at 5, 10, 15 and 20cm soil depth. The polyethylene sheets were removed after 40days period of solarization. After that groundnut seeds were sown with little disturbance of soil in treated plot. Pre-emergence herbicide metolachlor @1.5kg ai ha^{-1} was applied on 3DAS through knapsack sprayer with flood jet nozzle in specified plots as per treatments. The observation on weeds count, weed dry weight were recorded to work out weed control efficiency. Data on weed density and weed dry weight was subjected to square root transformation $\sqrt{x+0.5}$ before statistical analysis.

Results and Discussion

The weed flora observed in experimental trial included *Cleome viscosa, Vernonia cinera, Boerhaavia diffusa, Cynodon dactylon, Echinochola colonum, Phylanthus niruri, Digeria arvensis* and *Cyperus rotundus* were present predominantly and significantly altered by weed control treatments. *E. colonum* and *Boerhaavia diffusa* were present in lesser proportion during both years.

Off-Season land management practices

Weed density and drymatter of weeds:- Significant variations was observed on total weed density and weed dryweight with all treatments (Table.1).

Off season land management practices significantly reduced the weed population and weed dry weed weight at 30 and 60DAS. The lowest weed population (67.60 and 92.90 on 30 and 60 DAS) and dry weight (398.15kg ha^{-1} and 531.75kg ha^{-1}) was observed under soil solarization followed by glyphosate. While the highest population of weeds (145.85 and 201.35 on 30 and 60DAS) and weed dry weight (832.90 and 1160.41 kg ha^{-1} on 30 and 60 DAS) were recorded in fallow land. Reduction in weed population and weed dryweight due to high temperature reached during solarization may affect dormancy and reduced weed seed population (Grundy , 2003). The practice of irrigating soil before solarization could also influence induction of dormancy and avoiding dormancy induction altogether by causing seeds to germinate before exposure to high temperatures. Sublethal effect of high temperature, such as increased susceptibility to microbial infection may also contribute to reduced weed population and weed dryweight (Dahlquist *et al* 2007and solar scorching of emerged weeds. Thus solarization reducing the weed emergence and weed dryweight to

the minimum so there was considerable increase in weed control efficiency of these treatments (Sowmya et al., 2003).

Growth parameters

Off-season land management practices significantly influenced the plant height, LAI and dry matter production (Table.2). The maximum plant height of groundnut was recorded under soil solarization for 40 days and it was followed by glyphosate spray. The least plant height was observed in fallow treatment. The respective increase in growth character may be better control of weeds from the beginning time through several modes of action including thermal inactivation of weed seeds and weakening of propagules alters the plant root environment and results in better crop response interms of increased growth (Sundari. 2007).

Yield parameters

Soil solarization significantly increased the total number of pods and pod yield (Table.3). The highest pod yield was registered with soil solarization and it was followed by glyphosate spray. Lower pod yield was observed with fallow. The increase in yield attributes might be due to lower weed count, weed dry weight resulted in efficient utilization of available resources by crop. Further increased mineralization of nutrients resulting in superior yield attributes of groundnut.([Thimmegowda,2007)

Weed control measures

Population and drymatter of weeds

All weed management methods significantly reduced the weed population and weed dry matter compared to unweeded control (Table.1). Metolachlor followed by hand weeding + blackgram intercropping at 4: 1 ratio recorded significantly lower weed population (68.65 and 97.30 m^{-2}) and weed dry matter (446.80 and 551.25 kg ha^{-1}) at 30 and 60DAS than rest of weed management practices. Higher weed count and weed dryweight was recorded with unweeded control on 30 and 60DAS. Increased weed population and DMP to such a high level under unweeded control may be attributed to uninterrupted weed growth throughout the crop season. These are in close conformity with Nambi *et al* (2006).)Metolachlor pre emergence herbicide rapidly depletes the photosynthate reserves within weed system, through the process of induced respiration, inhibition of protein synthesis and photosynthetic activity, therefore most of the weeds died within a few days of their emergence. These herbicide gave almost season long control of weeds obviously due to their persistence in soil for a sufficiently long time.. In addition supplemental hand weeding and growing intercrops gave effective weed control. Intercropping system also suppressed weed population through smothering effect This findings corrobarate reports of Selvakumar and Sundari,(2008) and Nambi(2017).

Growth components

Weed control measures significantly increased the growth characters, viz., Plant height, LAI, and DMP over unweeded control (Table.2). Metolachlor + hand weeding + blackgram intercropping recorded the highest plant height, LAI and DMP than all of the weed control treatments and it was on par with metolachlor + blackgram intercropping and then followed by metolachlor + H.W on 30DAS. Plant grow vertically due to shading of groundnut by intercrops, shading increased the internodal length which in turn increased the plant height. This findings are inconcurrance with Ummed Singh *et al* (2008).

Yield components and yield

Metolachlor + hand weeding on 30DAS recorded the highest pod yield (1998.24 kg ha^{-1}) compared to other weed control practices (Table. 3). It was on par with hand weeding twice and followed by metolachlor + hand weeding + blackgram intercropping. Metolachlor + hand weeding produced more

number of pods, shelling percentage. This may be due to assured and comparatively weed free environment which influenced greater availability of phosphorus during pegging and subsequent growth stages, the internal translocation of photosynthetic substrates to pods and kernel were higher due to appreciable improvement in plant height. LAI etc,(Nagaraju and Mohankumar. 2009). Unweeded control recorded the lowest yield components due to heavy crop-weed competition throughout the crop growth stages. Metolachlor followed by hand weeding + blackgram intercropping at 4:1 ratio had better effect on weeds, improved growth characters but failed to express their superiority in pod yield. Intercropping caused competition for natural resources, shading effect during early stages resulted in reduced the yield of groundnut (Emuh, 2007)

Interaction

The interaction effect of off season land management practices and weed control practices on weed density and weed dry weight on 30 and 60DAS were found significant. In both stages solarization with application of metolachlor followed by hand weeding + blackgram intercropping at 4:1 ratio reduced the weed density and weed dry matter and increased the growth parameters and yield. Thus effect was also comparable with solarization with metolachlor + hand weeding on 30DAS.

Benefit: cost ratio was the highest with solarization with application of metolachlor followed by hand weeding + blackgram inter cropping at 4:1 ratio (Table-3). This may be due to smothering effect of blackgram and thus reduced the weed competition and resulted in better yield [32]. Increased benefit cost ratio due to additional cost return contributed by blackgram. Soil solarization with application of metolachlor followed by hand weeding + blackgram proved to be an effective, economic and feasible integrated weed management practice for irrigated groundnut.

Table 1: Effect of off season land management and weed control measures on weed parameters (mean of two years)

Treatments	Weed density (No. m^2)		Weed dry matter (kg /ha)		WCE
	30 DAS	60 DAS	30 DAS	60 DAS	
M_1	145.8 (12.09)	201.3 (14.2)	832.9 (28.86)	1160.4 (34.07)	29.32
M_2	85.0 (9.24)	110.9 (10.55)	479.4 (21.90)	620.4 (24.91)	65.06
M_3	119.1 (10.9)	161.1 (12.71)	667.5 (25.84)	914.9 (30.25)	42.68
M_4	67.6 (8.25)	92.9 (9.66)	398.1 (19.96)	531.75 (23.07)	72.13
CD	0.056	0.026	0.245	0.325	-
S_1	178.0 (13.36)	248.8 (16.7)	1036.2 (32.19)	1250.7 (35.37)	-
S_2	87.1 (9.36)	109.0 (10.46)	493.4 (22.22)	625.5 (25.01)	57.42
S_3	115.8 (10.7)	152.9 (12.38)	646.0 (25.42)	865.4 (29.42)	38.23
S_4	72.0 (8.51)	101.0 (10.07)	472.7 (21.75)	614.0 (24.78)	60.22
S_5	104.9 (10.26)	140.4 (11.87)	578.0 (24.05)	823.8 (28.71)	44.01
S_6	68.6 (8.31)	97.3 (9.88)	446.8 (21.14)	551.2 (23.48)	61.98
CD	0.070	0.047	0.388	0.287	-
M_1S_1	193.0 (13.9)	266.4 (16.33)	1136.3 (33.71)	1401.3 (37.44)	33.21
M_1S_2	133.8 (11.58)	178.0 (13.36)	748.4 (27.36)	1086.2 (32.96)	13.04
M_1S_3	164.4(12.84)	231.4 (15.22)	934.4 (30.57)	1317.4 (36.30)	38.67
M_1S_4	116.7 (10.82)	163.5 (12.80)	669.5 (25.88)	1029.0 (32.08)	21.52
M_1S_5	149.6 (12.25)	209.1 (14.47)	840.9 (29.00)	1199.9 (34.64)	40.19
M_1S_6	117.5 (10.86)	159.5(12.65)	668.2 (25.86)	928.4 (30.47)	15.28
M_2S_1	173.3 (13.18)	236.6 (15.39)	972.8 (31.19)	1313.6 (36.25)	69.51

M_2S_2	68.4 (8.30)	68.1 (8.28)	358.2 (18.93)	398.8 (19.98)	63.60
M_2S_3	89.6 (9.49)	91.0 (9.56)	547.5 (23.41)	635.6 (25.22)	71.60
M_2S_4	52.2 (7.25)	93.4 (9.69)	313.1 (17.71)	402.1 (20.06)	57.12
M_2S_5	80.8 (9.01)	103.9(10.22)	420.1 (20.50)	624.8 (25.00)	73.47
M_2S_6	46.2 (6.83)	64.1 (8.04)	264.1 (16.26)	347.7 (18.66)	7.08
M_3S_1	179.7 (13.45)	253.9 (15.95)	1059.6 (32.55)	1436.1 (37.90)	47.42
M_3S_2	105.5 (10.29)	133.1 (11.55)	632.1 (25.15)	740.1 (27.21)	28.85
M_3S_3	132.5 (11.53)	180.1 (13.43)	661.1 (25.72)	934.6 (30.58)	49.68
M_3S_4	86.8 (9.34)	127.4 (11.30)	506.8 (22.52)	736.4 (27.14)	35.96
M_3S_5	125.5 (11.22)	159.0 (12.62)	670.6 (25.90)	931.0 (30.52)	51.51
M_3S_6	83.9 (9.18)	125.1 (11.20)	474.9 (21.80)	711.0 (26.67)	18.03
M_4S_1	166.0 (12.90)	232.7 (15.27)	976.0 (31.24)	1293.7 (35.97)	78.06
M_4S_2	40.8 (6.42)	51.1 (7.18)	235.4 (15.35)	276.8 (16.65)	57.43
M_4S_3	76.6 (8.78)	99.6 (10.05)	441.1 (21.01)	574.1 (23.97)	80.98
M_4S_4	32.1 (5.71)	44.1 (6.68)	186.9 (13.69)	288.3 (16.99)	61.75
M_4S_5	63.1 (7.97)	89.7 (9.49)	380.2 (19.51)	539.5 (23.23)	82.75
M_4S_6	26.9 (5.23)	40.1 (6.37)	169.0 (13.01)	217.6 (14.76)	0.153
CD	0.140	0.071	0.180	0.621	-

Figures in Parenthesis indicates original values

Table 2: Effect of offseason land management practice and weed control measures on growth and yield parameters (mean of two years)

Treatments	Plant height (cm)	LAI	Dry matter production (Kg/ ha)	Total No. of pods	Shelling (%)
M_1	19.40	3.49	1358.97	7.63	71.25
M_2	24.52	4.17	2072.52	17.60	72.32
M_3	21.94	3.93	1753.18	13.58	71.63
M_4	26.83	4.42	2284.26	22.23	73.20
CD	0.665	0.116	108.73	1.065	NS
S_1	19.32	3.48	1615.79	9.64	68.44
S_2	24.01	4.24	2029.41	17.98	73.81
S_3	21.73	3.83	1765.23	13.12	71.29
S_4	25.37	4.31	2074.52	19.38	74.11
S_5	22.57	4.02	1851.23	14.84	71.98
S_6	25.76	4.14	2028.54	16.61	72.34
CD	0.617	0.092	84.199	0.820	NS
M_1S_1	15.82	3.04	1178.37	5.40	66.65
M_1S_2	20.52	3.75	1514.45	8.88	73.56
M_1S_3	18.14	3.29	1220.72	6.47	70.45
M_1S_4	20.97	3.83	1571.61	9.17	73.65
M_1S_5	19.11	3.46	1277.23	7.63	71.57
M_1S_6	21.88	3.61	1391.48	8.28	71.65
M_2S_1	20.83	3.61	1717.03	11.29	69.68
M_2S_2	24.83	4.42	2284.45	21.05	73.94
M_2S_3	23.29	4.02	1957.10	14.69	71.63
M_2S_4	26.93	4.46	2306.58	22.68	74.25
M_2S_5	23.68	4.22	2042.07	16.67	71.9
M_2S_6	27.58	4.32	2126.09	19.23	72.55
M_3S_1	17.69	3.42	1533.35	8.730	67.15
M_3S_2	23.01	4.16	1873.15	16.20	73.72

M_3S_3	20.12	3.77	1666.45	11.80	70.85
M_3S_4	24.54	4.23	1929.47	18.19	74.05
M_3S_5	20.91	3.92	1742.59	12.88	71.95
M_3S_6	24.96	4.08	1774.39	14.72	72.10
M_4S_1	22.77	3.87	2034.70	13.14	72.80
M_4S_2	27.68	4.65	2445.60	25.82	74.05
M_4S_3	25.39	4.24	2217.55	20.52	72.25
M_4S_4	29.01	4.71	2496.43	27.51	74.50
M_4S_5	26.61	4.48	2202.85	22.19	72.52
M_4S_6	29.45	4.58	2308.25	24.25	73.10
CD	1.304	0.166	160.498	1.841	NS

Table 3: Effect off season land management practices and weed control measures on yield and economics (mean of two years)

Treatments	100seed weight	Pod yield (Kg/ha)	Haulm Yield (kg/ha)	BCR
M_1	41.33	641.41	1509.38	0.43
M_2	44.14	1842.01	3311.23	1.16
M_3	43.27	1647.38	3107.39	0.58
M_4	45.15	2326.75	3989.31	1.75
CD	NS	97.950	98.17	-
S_1	39.47	612.96	1412.14	0.31
S_2	44.70	1919.90	3510.75	2.50
S_3	42.30	1666.56	2988.39	1.90
S_4	46.03	1998.24	3563.42	2.80
S_5	43.38	1710.08	3086.32	2.71
S_6	44.20	1805.19	3340.01	3.01
CD	NS	103.433	95.869	-
M_1S_1	38.05	505.26	1123.97	0.74
M_1S_2	43.70	728.02	1601.04	0.92
M_1S_3	37.80	568.56	1353.50	0.78
M_1S_4	44.15	877.62	1850.70	1.05
M_1S_5	41.53	583.26	1407.54	0.78
M_1S_6	42.80	660.81	1819.56	0.91
M_2S_1	39.90	654.31	1385.65	0.90
M_2S_2	45.55	2162.47	4046.00	2.61
M_2S_3	44.05	1955.19	3302.85	2.56
M_2S_4	46.05	2268.46	4027.39	2.71
M_2S_5	44.45	1992.13	3470.43	2.70
M_2S_6	44.60	2060.35	3635.09	2.73
M_3S_1	38.90	564.69	1359.79	0.75
M_3S_2	45.60	2048.43	3788.40	2.31
M_3S_3	42.53	1653.78	3105.94	2.09
M_3S_4	46.10	2079.73	3769.90	2.41
M_3S_5	42.55	1701.87	3217.77	2.22
M_3S_6	43.93	1835.70	3402.54	2.35
M_4S_1	41.05	727.72	1779.16	0.85
M_4S_2	47.50	2740.68	4607.57	2.86
M_4S_3	44.88	2487.52	4191.29	2.76
M_4S_4	47.01	2778.99	4605.71	2.99
M_4S_5	45.00	2563.11	4249.44	3.04
M_4S_6	45.48	2663.98	4502.74	3.22

CD	NS	216.2265	200.135	-

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