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Evaluation of Organic and Inorganic Weed Managmenet Practices in Groundnut (*Arachis hypogaea* L.)

S. Deivasigamani, D. Beulah Esther, S. Gowtham

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ABSTRACT

Background: Groundnut cultivation required frequent weed control practices for higher seed production, because groundnut is highly susceptible to weed infestation due to its slow growth rate at initial stage and its physiological characteristics like short plant height and underground pod bearing habit. To study the efficiency of two different aspects of weed control by organic and inorganic weed management on groundnut at Farmer's field of Karukupalayam village, Erode district, India.

Methods: A field investigation was conducted during *Kharif* season 2020-2021 at Krishna College of Agriculture and Technology, Affiliated to TNAU, Coimbatore-3, Tamil Nadu, India. The experiment was laid out in (RcBD) design with three replications. Ten different treatments are 1-5 were organic methods and 6-10 were inorganic methods.

Result: The results of the experiments revealed that organic and inorganic treatments were tried, the least weed density, weed dry weight, weed index (18.24%) and highest weed control efficiencyand highest pod yield (2.33 t/ha) and haulm yield (3.05 t/ha), BC ratio (2.56) recorded in inorganic treatment of T9-PE pendimethalin @ 1.5 kg/ha at 2 DAS + PoE Imazethapyr @0.075 kg/ha at 14-20 DAS. It is significantly superior to all other treatments.

Key words: *Arachis hypogaea*, Economics, Organic and inorganic weed management, Yield.

INTRODUCTION

Groundnut or peanut (*Arachis hypogaea* L.) is an important oilseed crop in our country which occupies first position in terms of area and second position in terms of production. Groundnut is known as the "*King*" of oil seed crop. It seeds contains high quality edible oil (48%), proteins (26%) and carbohydrates (20%). India has a diverse climate; as such groundnut is throughout the year in *kharif, rabi*, summer and spring seasons in one or other parts of the country. In India, groundnut was grown on 4.81 million ha during 2018-2019 with a total production of 6.73 million tonnes and an average productivity of 1393 kg/ha. In Tamil Nadu it occupied 0.335 million ha land with total production of 0.98 million tonnes with a productivity of 2620 kg/ha by Directorate of Economics and Statistics, DAC and FW, (2018-2019).

Groundnut cultivation required frequent weed control practices for higher seed production, because groundnut is highly susceptible to weed infestation due to its slow growth rate at initial stage and its physiological characteristics like short plant height and underground pod bearing habit (Vora *et al.,* 2019).

Weed interference resulted in yield losses ranging from 74 to 92% (Agastinho *et al*., 2006). Critical period of crop - weed competition for groundnut crop was reported to be upto 45 DAS and weed free environment during this period registered higher pod yield (Rao, 2000). Yield loss due to heavy weed infestation in groundnut ranged from 13 to 80% in India (Ghosh *et al.,* 2000).

Organic groundnut cultivation is a risky enterprise and this is largely due to difficulties in managing weeds using various methods acceptable for certified organic production. In contrast with conventional groundnut production that relies almost exclusively on synthetic herbicides for weed control, organic groundnut production relies on an integrated system of cultural, mechanical and thermal weed control (William Carroll Johnson, 2019).

Department of Agronomy, Krishna College of Agriculture and Technology, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.

Corresponding Author: S. Deivasigamani, Department of Agronomy, Krishna College of Agriculture and Technology, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India. Email: agrisiga2007@gmail.com

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MATERIALS AND METHODS

Field experiment was conducted during 2020-2021 irrigated condition at the farmer's field, Karukupalayam village, Erode district of Tamil Nadu (Under the Krishna College of Agriculture and Technology-KRISAT). The experimental field was red loamy soil with pH 6.5, available nitrogen (231 kg ha^{-1}), available phosphorus (16 kg ha^{-1}) and available potassium (293 kg ha^{-1}). The experimental farm located at 11.49′N latitude and 77.62′E longitudes at an altitude of 176 m above mean sea level. The average temperature of this regions ranging from 26.3 to 27.3°C. The average annual rainfall is 575 mm. The relative humidity ranged from 72 to

75 per cent. The experiment was laid out in RCBD design with three replications. The data obtained on various parameters were tabulated and subjected to statistical analysis by the method suggested by Snedecor and Cochran (1967). The comparison of treatment was tested with F test wherever„ F test shown their significance. The levels of treatment were compared by critical difference at 5% level of probability. The treatments consist of T_1- Straw mulching, T_2- wheel hoeing at 20 and 40 DAS, T_3- Groundnut+black gram intercropping, T_4- Hand hoeing at 20 and 40 DAS, T_5- weed free plot, T_6- PE pendimethalin 30EC @ 1 kg/ha at 2 DAS, T_7- PE- Oxyflurofen 23.5 EC @0.24 kg/ha at 2 DAS, T_8- PoE Imazethapyr 10 SL @100 g/ha at 14 DAS, T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE Imazethapyr @0.075 kg/ha at 14-20 DAS, T_{10}- Weedy plot (control).

The sowing was done on TMV 13 variety at 30×10 cm spacing. The recommended dose of 10 kg N, 10 kg P_2O_5 and 45 kg K_2O and gypsum 400 kg/ha was applied along with farmyard manure (FYM) at 12.5 t ha^{-1}. The whole quantity of P_2O_5, FYM and half dose of nitrogen and potassium were applied at the time of field preparation. Remaining half dose of N and K_2O was applied at 25 and 45 DAS. A full dose of Gypsum was applied at 45 DAS. The herbicides were sprayed by using knapsack sprayer fitted with flood jet nozzle as per the treatments.

Observations was recorded on weed density, weed dry weight, weed control efficiency, weed index, no of pods $plant^{-1}$, no of kernel pod^{-1}, 100 kernel weight, pod yield and haulm yield were recorded. Geethadevi *et al.,* (2017) reported that Pendimethalin @ 0.75 kg/ha as pre-emergence (PE) + Imazthapyr @ 75 g/ha as post emergence (PoE) herbicides at 21 DAS + Inter cultivation with wheel hoeing fallowed by hand weeding resulted in higher growth attributes, yields attributes and net returns over un weeded.

RESULTS AND DISCUSSION

Effect on weed parameters

Weed density

Data was recorded at 30, 60, 90 DAS (Table 1) were significantly influenced by different organic and inorganic treatments.

Among the treatments lowest weed populations was recorded under inorganic treatment (T_9)- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE Imazethapyr @ 0.075 kg/ha at 14-20 DAS and the values are 20.12, 27.18,14.32 per 0.25 m^2 at 30,60 and 90 DAS respectively. The probable reasons for obtaining lowest weed populations under this best might due to lesser weed competition faced by groundnut crop as pre-emergence applications of pendimethalin resulted in better weed management during initial stages of crop growth and later growth weeds are suppressed by post -emergence applications of Imazthapyr at 14-20 DAS. Followed by T_6- Pre-emergence application of Pendimethalin @ 1 kg/ha at 2 DAS gives the values are 20.33, 29.83, 16.16 per 0.25 m^2 at 30, 60, 90 DAS respectively. The lowest weed populations

Table 1: Weed density, weed dry weight, weed control efficiency and weed index influenced by different weed control treatments.

Treatments	Weed density (No/0.25 m^2)			Weed dry weight (g/0.25 m^2)			Weed control efficiency (%)			Weed index (%)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	At harvest	
T_1- Straw mulching	29.33	38.87	20.57	14.57	19.65	14.77	71.38	68.62	65.17	32.98
T_2- Wheel hoeing at 20 and 40 DAS	27.43	37.45	17.43	14.48	19.13	14.09	71.55	69.45	66.77	30.58
T_3- Groundnut+black gram intercropping	30.14	39.36	20.98	14.99	20.68	15.02	70.55	66.98	64.58	33.68
T_4- Hand hoeing at 20 and 40 DAS	26.83	32.00	14.43	13.89	15.26	10.43	72.56	75.62	75.40	20.00
T_5- Weed free plot	-	-	-	-	-	-	100	100	100	-
T_6- PE pendimethalin 30 EC @ 1 kg/ha at 2 DAS	20.33	29.83	16.16	11.02	16.96	14.65	78.30	72.81	66.03	21.40
T_7- PE oxyflurofen 23.5 EC @ 0.24 kg/ha at 2 DAS	26.66	37.66	20.33	13.37	18.97	14.59	72.64	69.29	65.50	24.56
T_8- PoE imazethapyr 10 SL @ 100 g/ha at 14 DAS	30.00	39.83	21.16	13.48	19.73	15.00	73.43	68.44	64.58	27.71
T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE imazethapyr @ 0.075 kg/ha at 14-20 DAS	20.12	27.18	14.32	10.89	15.06	10.02	78.60	75.93	76.37	18.24
T_{10}- Weedy plot (control)	94.33	104.16	56.66	50.91	62.63	42.41	-	-	-	57.54
S.Ed	1.16	1.41	0.97	1.12	1.28	0.89	1.03	1.22	1.31	1.29
C.D (P=0.05)	2.43	2.96	1.91	2.35	2.68	1.86	2.16	2.56	2.75	2.71

*DAS: Days after sowing; PE: Pre emergency; PoE: Post emergency; EC: Emulsifiable concentrate; SEd: Standard error; CD: Critical difference.

were recorded at under T_4- Hand hoeing at 20 and 40 DAS and the values are 26.83, 32.00, 14.43 per 0.25 m^2 at 30, 60, 90 DAS respectively. Meyyappan and Kathiresan (2005) opined that hand weeding twice significantly increased the kernel yield of groundnut up to 2.42 times than un weeded control in clay loam soils of Tamil Nadu.

Weed dry weight

In overall treatments was observed minimum weed dry weight of 10.89, 15.52, 14.47 g per 0.25 m^2 were observed at 30, 60 and 90 DAS respectively under inorganic treatment T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE Imazethapyr @0.075 kg/ha at 14-20 DAS because the lowest weed population resulted in reduced weed dry weight. Jhala *et al.,* (2005) reported that minimum weed dry matter accumulated (70 kg/ha). Whereas the Highest weed dry weight of 50.91, 62.63, 42.41 g per 0.25 m^2 were observed at 30, 60 and 90 DAS respectively under T_{10}- weedy plot (control). In organic weed control methods, minimum weed dry weight of 13.89, 15.26, 10.43 g per 0.25 m^2 were observed at 30, 60 and 90 DAS respectively under treatment T_4- hand hoeing at 20 and 40 DAS.

Weed control efficiency

Data on weed control efficiency clearly shows (Table 2). Among the various organic and inorganic treatments tried, the maximum weed control efficiency of 78.60, 75.93, 76.37 per cent were recorded at 30, 60, 90 DAS respectively under inorganic weed treatment T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE Imazethapyr @0.075 kg/ha at 14-20 DAS. Followed by T_6- Pre-emergence application of pendimethalin @ 1 kg/ha at 2DAS gives the values 78.30 per cent were recorded at 30 DAS. Jhala *et al.,* (2005) reported that higher weed control efficiency (90.70%) was recorded under an integrated method which is obtained by application of pendimethalin at 1.0 kg/ha + hand weeding at 30 DAS.

In organic weed control method, the maximum weed control efficiency was recorded at under T_4- Hand hoeing at 20 and 40 DAS and the values 72.56, 75.62, 75.40 per cent was found significantly over all other organic weed management treatment at 30, 60, 90 DAS respectively. Kalaichelvi *et al.* (2015), reported that pre-emergence application of oxyflurofen at 0.25 kg/ha fallowed by hand weeding on 20 DAS has recorded higher weed control efficiency (97.2, 96.8% at 40 and 60 DAS respectively).

Weed index

Among the various weed management treatments tried, the minimum weed index was found in inorganic weed management treatment T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE Imazethapyr @0.075 kg/ha at 14-20 DAS and the values are 18.24 per cent and followed by organic weed management treatment T_4- Hand hoeing at 20 and 40 DAS (20.00). Kalhapure *et al.,* (2013) reported that the weed free check, two hand weeding at 20 DAS and 40 DAS and manually uprooting of weeds at (60 DAS) was found more effective to control of weeds in groundnut, lower weed index (0%) and highest weed control efficiency (91.4%).

Table 2: Effect of different treatments on crop yield and economics analysis.

Treatments	No. of plants/ 0.25 m^2	No. of pods/ plants	Test weight	Pod yield (t/ha)	Haulm yield (t/ha)	Economics			
						Cost of cultivation	Gross returns	Net returns	B:C ratio
T_1- Straw mulching	6.94	17.02	40.27	1.91	2.57	32350	76400	44050	2.36
T_2- Wheel hoeing at 20 and 40 DAS	6.79	17.76	41.03	1.98	2.69	33400	79200	45800	2.37
T_3- Groundnut+black gram intercropping	7.01	16.98	39.02	1.89	2.51	38700	81300	42600	2.10
T_4- Hand hoeing at 20 and 40 DAS	7.58	17.89	42.09	2.28	2.89	38200	91200	53000	2.38
T_5- Weed free plot	7.60	19.98	47.71	2.85	3.33	40920	109840	68920	2.68
T_6- PE pendimethalin 30 EC @ 1 kg/ha at 2 DAS	7.12	18.87	42.53	2.24	3.02	35350	89600	54350	2.53
T_7- PE oxyflurofen 23.5 EC @ 0.24 kg/ha at 2 DAS	7.09	18.04	42.85	2.15	2.15	35400	86000	50600	2.42
T_8- PoE imazethapyr 10 SL @ 100 g/ha at 14 DAS	6.99	17.95	41.89	2.06	2.76	35360	82400	47040	2.33
T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE imazethapyr @ 0.075 kg/ha at 14-20 DAS	7.2	19.76	45.93	2.33	3.05	36280	93200	56920	2.56
T_{10}- Weedy plot (control)	5.9	15.09	35.90	1.21	2.03	29120	48400	19280	1.66
S.Ed	0.56	0.39	0.47	0.32	0.29	-	-	-	-
C.D (P=0.05)	1.17	0.81	0.67	0.67	0.60	-	-	-	-

*DAS: Days after sowing; PE: Pre emergency; PoE: Post emergency; EC: Emulsifiable concentrate; SEd: Standard error; CD: Critical difference.

Effect on yield parameters

Pod yield and haulm yield

Among the various treatments tried, the highest pod yield recorded under treatment T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE imazethapyr @0.075 kg/ha at 14-20 DAS (2.33 t/ha) and haulm yield (3.05 t/ha). Geethadevi *et al.,* (2017) reported that pendimethalin @ 0.75 kg/ha as pre emergence (PE) + Imazthapyr @ 75 g/ha as post emergence (PoE) herbicides at 21 DAS + Inter cultivation with wheel hoeing fallowed by hand weeding resulted in higher yields attributes and net returns over un weeded control.

The probable reasons for obtaining under treatment T_{10}- might be due to lesser weed competition faced by groundnut crop as pre-emergence applications of pendimethalin resulted in better weed management during initial stages of crop growth and later weeds are suppressed by post-emergence applications of Imazthapyr at 14-20 DAS, followed by organic weed management T_4- Hand hoeing at 20 and 40 DAS (2.28 t/ha). Kabita Mishra, (2020) concluded that application of Oxyflurofen 23.5 EC @0.2 kg/ha at 2 DAS followed by Imazethapyr 10% SL @ 100 g/ha at recorded higher pod yield (2.7/ha).

Economics

Among the various treatments tried, T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE Imazethapyr @0.075 kg/ha at 14-20 DAS recorded the highest return rupee^{-1} invested of Rs. 2.56. Tomar *et al.,* (2009) reported that pre-emergence application of pendimethalin at 1.0 kg/ha registered higher pod yield of 1884 kg/ha, net return of Rs. 25070 and BCR of 4.60.

Followed by T_6- Pre-emergence application of Pendimethalin @ 1 kg/ha at 2 DAS was recorded the return rupee^{-1} invested of 2.53 while the least return rupee^{-1} invested of Rs. 1.66 was observed in the treatment T_{10}- Weedy plot (control). Kabita Mishra, (2020) concluded that application of oxyflurofen 23.5 EC @0.2 kg/ha at 2 DAS followed by imazethapyr 10% SL @ 100 g/ha at recorded the highest net return (Rs. 71309/ha) and BCR (2.79) which were higher than farmers practices of hand weeding at 20 DAS.

CONCLUSION

Based on these results concluded that, among the various organic and inorganic weed management practices tried, the lowest weed density, weed dry weight, highest weed control efficiency, minimum weed index (18.24 per cent) and highest pod yield (2.33 t/ha) and haulm yield (3.05 t/ha), BC ratio (2.56) was recorded in T_9- PE pendimethalin @ 1.5 kg/ha at 2 DAS+PoE Imazethapyr @0.075 kg/ha at 14-20 DAS. It is significantly superior to all other treatments. Followed by T_4- Hand hoeing at 20 and 40 DAS.

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