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Integration of chemical and cultural methods for weed management in groundnut

A.H. Kalhapure*, B.T. Shete and P.S. Bodake

Breeder Seed Production Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra 413 722

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ABSTRACT

A field experiment was conducted to study the integrated weed management in groundnut (*Arachis hypogaea* L.) for consecutive two *Kharif* seasons in 2010 and 2011 at Rahuri with combination of 12 weed management treatments in three replications. Weed free check (two hand weeding at 20 and 40 DAS and manually uprooting of weeds at 60 DAS) was found more effective to control weeds in groundnut and recorded lowest weed density, wed dry matter and weed index and highest weed control efficiency. It was also recorded significantly highest growth and yield attributes in groundnut over all the other treatments *viz.* plant height, dry matter weight of plant, number of pods/plant and pod yield/hectare. Though highest gross monetary returns (₹ 1,09,845/ha) was recorded in treatment weed free check, maximum net monetary returns (₹ 61,460/ha) and B:C ratio (2.42) were recorded in the treatment application of pendimethalin 1.5 kg/ha as pre-emergence + imazethapyr 0.150 kg/ha as post-emergence + one hand weeding at 40 DAS which was found most economically feasible weed management practice for groundnut.

Key words: Cultural methods, Economics, Groundnut, Herbicides, Weed dynamics, Weed management, Yield

Groundnut is an important oilseed crop of India which is cultivated in nearly 6 million ha area with the production of 7.5 million tones and average productivity of 1.27 t/ha. Though India ranks first in the world under groundnut area, there is need to import 8.03 million tons of edible oil. The principle reasons behind this are lower productivity and losses of commodity at the time of various stages of crop production. Cultivation of groundnut as rain fed crop, lack of knowledge among the farmers about cultivation of groundnut with modern technology, unawareness of improved varieties and improper fertilization *etc*. are some causes of lower productivity of groundnut in India. Along with these, the major cause of minimizing production is severe weed infestation in crop. In India, yield losses of groundnut due to weeds ranged from 13-80% (Ghosh *et al.* 2000).

Weeding and hoeing are common cultural and manual weed management methods for groundnut, but with considering the scarcity of labours, these methods are very costly and tedious. Mechanically operated power weeder can not be used after peg initiation of groundnut. On the other hand, use of herbicides is also limited due to their selectivity. Hence the agronomic investigation was conducted to find out practically convenient and economically feasible combination of chemical and cultural methods of weed management in groundnut.

***Corresponding author:** aniketmpkv@gmail.com

MATERIALS AND METHODS

The experiment was conducted at Breeder Seed Production Farm of Mahatma Phule Krishi Vidyapeeth, Rahuri for two consecutive *Kharif* seasons of the years 2010 and 2011 in randomized block design with 12 treatments replicated thrice. The experimental site was located at 19^0 47' N latitudes and 74^0 81' E longitudes with average annual rainfall of 520 mm. The soil of experimental field was medium deep with pH 6.2, available N 380 kg/ha, $P_2O_5$14.5 kg/ha and K_2O 275 kg/ha. The treatments consisted of combination of hand weeding with pre-plant incorporation of fluchloralin 1.5 kg/ha, pre-emergence application of pendimethalin 1.5 kg/ha and post-emergence application of imazethapyr 0.150 kg/ha (Table 1).

Groundnut variety *'TAG- 24'* was sown in first fortnight of July during both the experimental years with plant spacing of 45 x 15 cm^2 on flat beds. The recommended dose of fertilizer 25 : 50 : 00 kg/ha N, P_2O_5 and K_2O was applied as half of N and full P_2O_2 and K_2O at the time of sowing and remaining N was applied one month after sowing the crop. Protective irrigations were applied whenever it was necessary during the crop growth. Fluchloralin was applied one day before sowing as pre-plant incorporation in soil and pendimethalin was applied one day after sowing as pre-emergence, whereas imazethapyr was applied 20 days after sowing as post-emergence as per the treatment details (Table 1) with knapsack sprayer. Weed free

check was achieved by two hand weedings at 20 and 40 DAS and manual uprooting of weeds at 60 DAS. Randomly five plants were selected from each plot and regular biometric observations of crop and weed parameters were recorded from 30 DAS up to harvest. However, observation data recorded at the peck growth period of crop *i.e.* 90 DAS is given in tables for study the results and discussion. Weed density (no./m^2) and dry weight of weeds (g/m^2) were recorded by putting a quadrate of $0.25m^2$ at two random spots in each plot. Weed control efficiency and weed index was calculated by standard formulae. For economic study, prevailing market price was used for different outputs and inputs.

RESULTS AND DISCUSSION

Effect on weeds

Predominant weeds in experimental groundnut field were: *Parthenium hysterophorus, Amaranthus viridis, Portulaca oleracea, Argemone mexicana, Euphorbia* spp., *Solanum nigrum, Echinochloa colonum, Cyperus rotundus* and *Cynodon dactylon*.

All the treatments were responsible for significant reduction in weed density and dry weight of weeds over control. Treatment of weed free check resulted in lowest weed density and dry weight of weeds. However, treatment weed free check, pendimethalin 1.5 kg/ha as PE + imazethapyr 0.150 kg/ha as POE+ one hand weeding at 40 DAS and fluchloralin 1.5 kg/ha as PPI + imazethapyr 0.150 kg/ha as POE + one hand weeding at 40 DAS were found to be at par with each other in respect of these weed parameters.

Highest weed control efficiency and lowest weed index percentage were observed in weed free check. Pendimethalin 1.5 kg/ha as PE + imazethapyr 0.150 kg/ha as POE + one hand weeding at 40 DAS was found next superior treatment after weed free check in respect of all weed parameters. This might be due to pre-plant soil incorporation of fluchloralin and pre-emergence application of pendimethalin which prevented emergence of monocot and grassy weeds by inhibiting root and shoot growth, while imazethapyr was responsible for inhibition of acetolactate synthase (ALS) or acetohydroxyacid synthase (AHAS) in broad-leaved weeds which caused destruction of these weeds at 3-4 leaf stage. Remaining monocot weeds were controlled by hand weeding at 40 DAS and manual uprooting at 60 DAS. Lowest weed control efficiency and highest weed index percentage were recorded in weedy check (control). Integration of hand weeding with pre- and post-emergence herbicides resulted significant reduction in dry matter production by weeds (Walia *et al*. 2007). Dubey and Gangwar (2012) have also found lower weed biomass, weed index and higher weed control efficiency with post-emergence application of imazethapyr and two hand weeding in groundnut.

Table 1. Effect of different weed management practices on weed parameters in groundnut at 90 DAS (pooled mean)

Treatment	Weed density (no./m^2)	Weed control efficiency (%)	Weed index (%)
Fluchloralin 1.5 kg/ha as PPI + imazethapyr 0.150 kg/ha as POE	37.88	74.60	43.93
Imazethapyr 0.150 kg/ha as POE + one hand weeding at 40 DAS	26.62	87.44	26.98
Pendimethalin 1.5 kg /ha as PE	47.94	67.94	61.78
Fluchloralin 1.5 kg/ha as PPI + imazethapyr 0.150 kg/ha as POE + one hand weeding at 40 DAS	22.19	87.83	18.26
Imazethapyr 0.150 kg/ha as POE	41.54	69.31	54.52
Fluchloralin 1.5 kg/ha as PPI + one hand weeding at 20 DAS	31.34	78.71	38.22
Pendimethalin 1.5 kg/ ha as PE+ imazethapyr 0.150 kg/ha as POE+ one hand weeding at 40 DAS	19.54	89.94	5.13
Pendimethalin 1.5 kg/ha as PE+ one hand weeding at 20 DAS	30.71	82.53	35.37
Fluchloralin 1.5 kg/ha as PPI	50.28	65.66	57.91
Pendimethalin 1.5 kg/ha as PE+ imazethapyr 0.150 kg/ha as POE	36.29	73.82	41.97
Weed-free	16.66	91.40	0.00
Weedy check	124.39	0.00	69.52
LSD (P=0.05)	7.63	-	-

PPI- Pre-plant incorporation; PE- Pre-emergence; POE- Post-emergence

Effect on crop

Weed-free recorded significantly taller plants and higher dry matter production and pod yield/hectare over all the other treatments. This was followed by treatment pendimethalin 1.5 kg/ha as PE + imazethapyr 0.150 kg/ha as POE + one hand weeding at 40 DAS. However in respect of number of pods/plant, weed free check and pendimethalin 1.5 kg/ha as PE + imazethapyr 0.150 kg/ha as POE + one hand weeding at 40 DAS were found at par with each other. This might be due to minimizing the competition of weeds with main crop for resources *viz.* space, light, nutrients and moisture with adaption of effective weed control methods. Singh and Giri (2001) has also concluded that proper weed control was responsible for increase in plant height and dry matter production in groundnut. Weed free environment in crop also facilitated better peg initiation and development at the critical growth stages of groundnut which tends to increase in number of pods/plant and pod yield/hectare. Higher profitable pod yield of summer groundnut was also reported by Raj *et al*. (2008) with keeping the crop in weed free condition. Significantly lower values of plant height, number of pods and pod yield were recorded in treatment weedy check.

Number of kernels/pod was recorded highest in weed free check, but there was no significant effect of weed management practices on number of kernels per pod in groundnut.

Economics

Weed-free check recorded significantly highest gross returns, which was ₹ 1,09,845/ha, whereas highest net returns (₹ 61,460) and B:C ratio (2.42) were recorded in treatment pendimethalin 1.5 kg/ha as PE + imazethapyr 0.150 kg/ha as POE+ one hand weeding at 40 DAS. This might be due to the cost of cultivation of groundnut crop was increased in treatment weed free check due to the higher need of human labours and their higher wages. This cost was reduced in treatment pendimethalin 1.5 kg/ha as PE + imazethapyr 0.150 kg/ha as POE+ one hand weeding at 40 DAS by using herbicides to effective control of weeds with minimizing human labours. Sasikala *et. al*. (2004) and Rao *et. al.* (2011) have also reported higher net return and B:C ratio with integration of pre- and post-emergence application of herbicides with hand weeding in groundnut. Weedy check (control) recorded lowest gross monetary return (₹ 33,660/ha), net monetary return (₹ 2,140/ha) and B:C ratio (0.94).

Table 2. Effect of different weed management practices on growth, yield and economics of groundnut (pooled mean)

Treatment	Plant height at 90 DAS (cm)	No. of pods/plant	No. of kernels/pod	Pod yield (t/ha)	Gross returns (x 10^3 ₹/ha)	Net returns (x 10^3 ₹/ha)	B:C ratio
Fluchloralin 1.5 kg/ ha as PPI+ imazethapyr 0.150 kg/ ha as POE	22.27	16.8	2.19	1.38	61.92	22.66	1.58
Imazethapyr 0.150 kg/ha as POE+ one hand weeding at 40 DAS	25.18	19.5	2.34	1.79	80.64	38.84	1.93
Pendimethalin 1.5 kg /ha as PE	21.61	14.8	2.27	0.94	42.21	4.91	1.13
Fluchloralin 1.5 kg/ha as PPI+ imazethapyr 0.150 kg/ha as POE + one hand weeding at 40 DAS	25.37	19.5	2.34	2.01	90.27	46.97	2.08
Imazethapyr 0.150 kg/ha as POE	22.03	16.3	2.19	1.12	50.22	12.42	1.32
Fluchloralin 1.5 kg/ha as PPI + one hand weeding at 20 DAS	24.21	17.3	2.34	1.52	68.22	26.92	1.65
Pendimethalin 1.5 kg/ ha as PE+ imazethapyr 0.150 kg/ha as POE+ one hand weeding at 40 DAS	26.49	21.2	2.36	2.33	104.76	61.46	2.42
Pendimethalin 1.5 kg/ha as PE+ one hand weeding at 20 DAS	24.9	18.3	2.26	1.58	71.14	29.84	1.72
Fluchloralin 1.5 kg/ha as PPI	20.06	14.7	2.26	1.03	46.48	9.18	1.25
Pendimethalin 1.5 kg/ha as PE+ imazethapyr 0.150 kg/ha as POE	22.46	17.3	2.24	1.42	64.08	24.78	1.63
Weed-free	29.12	22.0	2.41	2.45	109.84	60.04	2.21
Weedy check	16.84	11.2	2.17	0.75	33.66	-2.14	0.94
LSD (P=0.05)	2.01	1.6	NS	0.12	3.33	2.90	-

Treatment pendimethalin 1.5 kg/ha as PE + imazethapyr 0.150 kg/ha as POE + one hand weeding at 40 DAS proved practically more convenient and economically best feasible integrated weed management practice for groundnut. Considering the present condition of scarcity and high cost of labours, quality of weed control, yield and B:C ratio of cultivation of groundnut,

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