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Effect of weed control methods on growth and yield of groundnut

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ABSTRACT : A field experiment was conducted during *Kharif* 2011 to study the effect of weed control methods on growth and yield of groundnut (*Arachis hypogaea* L.) at Agronomy Section, SHIATS, Allahabad (U. P.). The experiment was laid out in Randomized Block Design (RBD). Ten treatment combinations were tested in three replications. The experiment comprised as T_1-control, T_2-weed free, T_3-one hoeing at 21 DAS, T_4-two hoeing at 21 and 45 DAS, T_5-oxyfluorfen 23.5 EC @ 0.2kg ha^{-1} at 2 DAS, T_6-oxyfluorfen 23.5 EC @ 0.2 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS, T_7-pendimethalin 30 EC @ 1 kg ha^{-1} at 2 DAS, T_8-pendimethalin 30 EC 0@ 1 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS, T_9-imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS and T_{10}-imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS + one hoeing at 45 DAS. It is evident from the results that, the treatment T_8-pendimethalin @ 1 kg ha^{-1} at 2 DAS + 1 hoeing at 45DAS was proved to be significantly superior than other treatments and control in respect of plant height, plant dry weight accumulation, number of branches per plant^{-1}, number of pods per plant, pod yield (t ha^{-1}), number of kernels per pod, kernel yield (t ha^{-1}), weed index, weed control efficiency as well as lowest weed population (No./0.25m^2) and weed dry weight (g/0.25m^2). Although the values obtained in the treatment T_4-two control hoeing at 21 and 45 DAS, T_6-oxyfluorfen 23.5 EC at 2 DAS + 1 hoeing at 45 DAS and T_{10}-imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS + 45 DAS were found to be statistically at par to that obtained in the treatment T_8 and the values were found to be significantly higher than all other weed management treatments.

KEY WORDS : Groundnut, Weed control methods, Chemical, Mechanical, Growth

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Groundnut (*Arachis hypogaea* L.) adorned as king of oilseeds, is one of the most important and ancient edible oilseed crop grown in India. India and China are the world's largest producers of groundnuts, accounting for over 41 per cent and over 18 per cent of world production, respectively. In 2010-11 all over India, more than 22 states where groundnut is grown in *Kharif/ Rabi* or in both seasons, where the area was 4.93 million hectares, production 5.64 million tones and the highest yield was 1144 kg hectare^{-1} (Anonymous, 2011). The yield of groundnut crop depends upon various agronomic management practices and there are several reasons for low productivity. One of the major factors responsible for low productivity of groundnut is weed infestation. As groundnut is grown mainly in the rainy season when the condition is more favourable for weed growth which encourages repeated flushes of grasses and broad leaved weeds during the entire season for competition with the crop, specially during early stages of crop growth. Due to slow growth of crop in the initial stages, weeds compete with the crop dominantly. The critical period for crop – weed competition was reported to be upto 45 days

after sowing and yield losses upto 70 per cent was recorded in groundnut due to weed infestation (Prasad *et al.*, 2002).

Weeds are generally controlled with the conventional methods i.e. cultural manipulation either by hand weeding or hoeing which is very effective but it is not only labourious amd insufficient but also expensive *i.e.* most of times due to continuous rains, scarcity of labours during peak period and financial limitations, it make weeding difficult after the initiation of reproductive stages of growth and it also hinders the pegging and pod development and effective and economic weed control on large scale is not possible through age old practice of manual and mechanical means. Thus, there is need to evolve efficient and economical viable system for managing weeds. Therefore, an experiment was carried out to find out most effective and cheaper weed control methods for harnessing the yield of *Kharif* groundnut in terms of both quality and quantity. Thus, herbicides are the only alternatives left under such circumstances of unavailability of labours, high cost of labours and unfavorable environment.

Chemical weed control is easier, time saving and economical as compared to hand weeding alone. Presently a wide variety of old and new generation herbicides are available and being recommended for usage. Among them pendimethalin, oxyfluorfen and imazethapyr were used to manage weeds in groundnut in this experiment.Use of chemical herbicides in oilseeds is observed to be very effective in weed management and boosting the yield of groundnut (Prabhakaran *et al*., 1996; Brar and Mehra, 1989).

Therefore, to find out the most suitable weed control method, the present investigation on effect of weed control methods on growth and yield of groundnut (*Arachis hypogaea* L.) was carried out during *Kharif* season of 2011 at the Crop Research Farm, Department of Agronomy, Allahabad School of Agriculture, SHIATS, Allahabad.

RESEARCH PROCEDURE

The experiment was conducted in Crop Research Farm, Department of Agronomy, Allahabad School of Agriculture, SHIATS, Allahabad (U.P.) during *Kharif* 2011 which is located at 25^0 24' 42" N latitude, 81^0 50' 56" E longitude and 98 m altitude above the mean sea level. The soil was sandy loam in texture having 7.4 pH, 0.72 per cent organic carbon, 114.8 total N and available P_2O_5 and K_2O of 17.14 and 156.2 kg ha^{-1}, respectively. The experiment was carried out in Randomised Block Design (RBD) with ten treatment combinations and three replications. The ten treatment combinations comprised of mechanical and chemical weed control methods as T_1-control, T_2-weed free, T_3-one hoeing at 21 DAS, T_4-two hoeing at 21 and 45 DAS, T_5-oxyfluorfen 23.5 EC @ 0.2kg ha^{-1} at 2 DAS, T_6-oxyfluorfen 23.5 EC @ 0.2 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS, T_7-pendimethalin 30 EC @ 1 kg ha^{-1} at 2 DAS, T_8-pendimethalin 30 EC @ 1 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS, T_9-imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS and T_{10}-Imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS + one hoeing at 45 DAS. Groundnut var. Kaushal (G-201) was sown with a spacing of 30 cm x 10 cm with a uniform basal dose of 80:40:40 (N: P_2O_5: K_2O, respectively). The herbicides, pendimethalin and oxyfluorfen were applied as pre-emergence at 2 days after sowing and imazethapyr was applied as post-emergence at 14 days after sowing with a spray volume of 800 litres of water per hectare. Crop germination was observed at 10^{th} day following sowing in each plot. Weed dry weight was recorded by placing a quadrate of 0.25 m^2 at 3 random places in each plot and then weighed for both monocot and dicot weeds separately after oven drying 45 days after sowing and harvesting. Observations on yield attributing characters and seed yield were recorded. Weed control efficiency was calculated as per formula Patil and Patil (1983). Weed index was calculated as per formula suggested by Gill and Kumar (1969). The net monetary returns were also determined for each treatment.

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

Weeds flora :

The dominant weed flora in the experimental field were *Cyperus rotundus, Dactyloctenium aegypteium, Digera arvensis,Tridex procumbens, Phyllantus niruri, Commelina benghalensis, Eclipta alba, Chenopodium album, Parthenium* spp. *Cynodon dactylon, Echinochloa* spp. and *Digitaria sanguinalis.*

Weed population under different treatments:

A critical review of the Table 1 clearly shows that at 30, 60 and 90 DAS among the various weed management treatments tried, the lowest weed population was recorded under treatment T_8-Pendimethalin @ 1 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS and the values (9.33 No./0.25 m^2) was found significantly superior over all other weed management treatments at 60 and 90 DAS except 30 DAS. The probable reasons for obtaining lowest weed population under this best might be due to lesser weed competition faced by groundnut crop as pre-emergence application of pendimethalin resulted in better weed management during initial stages of crop growth and the later growth of weeds was checked by hoeing at 45 DAS. Similar results were also reported by Sumathi *et al*. (2000) and Mishra *et al.* (2012). The highest weed population was recorded under the treatment T_1-Control at 30, 60 and 90 DAS. The treatment T_3-One hoeing at 21 DAS and T_9-Imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS were found at par with each other at 30 and 90 DAS. At 60 DAS treatment T_3-One hoeing at 21 DAS and T_5-oxyfluorfen 23.5 EC @ 0.2 kg ha^{-1} at 2 DAS were found at par with each other. The treatment T_4-Two hoeing at 21 and 45 DAS, T_6-Oxyfluorfen 23.5 EC @ 0.2 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS, T_7-Pendimethalin 30 EC @ 1 kg ha^{-1} at 2 DAS, and T_{10}-Imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS + one hoeing at 45 DAS showed highest weed population.

Weed dry weight :

Minimum weed dry weight of 10.71, 12.39 and 9.50 g per 0.25 m^2 were observed at 30,60 and 90 DAS, respectively under treatment T_8-Pendimethalin @1 kg ha^{-1} + 1 hoeing at 45 DAS whereas, the maximum weed dry weight of 50.91, 62.63 and 42.41 g per 0.25 m^2 were observed at 30, 60 and 90 DAS, respectively in treatment under T_1-(control) (Table 2). Lowest weed dry weight was recorded under treatment pendimethalin 30 EC @ 1 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS and the values were found to be significantly superior over that all other weed management treatments. The reduced plant population due to the application of pendimethalin resulted in reduced weed dry weight. The highest weed dry weight was recorded in weedy check plot. These result obtained during investigation are in close accordance with the finding of Shankarnarayan *et al*. (2000) and Attarde *et al.* (2001).

Weed control efficiency :

Maximum weed control efficiency of 78.82, 80.15 and 77.52 per cent were recorded at 30,60 and 90 DAS, respectively under treatment T_8 -Pendimethalin @1 kg ha^{-1} + 1 hoeing at 45 DAS. A critical review of the Table 2 clearly shows that the highest weed control efficiency was recorded under treatment T_2-weed free. At 30,60 and 90 DAS, among the various weed management treatments tried, the highest weed control efficiency was recorded under treatment T_8-pendimethalin @ 1 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS. Although the values obtained at 30 DAS under the treatment T_7-pendimethalin @ 1 kg ha^{-1} at 2 DAS and at 90 DAS under the treatment T_4-two hoeing at 21 and 45 DAS, T_6-oxyfluorfen @ 0.2

Table 1 : Effect of different weed control methods on weed population in groundnut at different intervals

Treatments	Weed population (No./0.25 m^2)		
	30 DAS	60 DAS	90 DAS
T_1-Weedy check	94.33	104.16	56.66
T_2-Weed free	-	-	-
T_3- One hoeing at 21 DAS	30.00	37.50	21.00
T_4- Two hoeing at 21 and 45 DAS	26.83	32.00	14.83
T_5- Oxyfluorfen 23.5EC @ 0.2kg/ha at 2 DAS	26.66	37.66	20.33
T_6- Oxyfluorfen 23.5EC+ 1 hoeing at 45 DAS	25.16	33.00	12.50
T_7- Pendimethalin 30EC @ 1 kg/ha at 2 DAS	20.33	29.83	16.16
T_8- Pendimethalin 30EC + 1 hoeing at 45 DAS	21.66	23.40	9.33
T_9- Imazethapyr 10% SL @ 100 g/ha at 14 DAS	30.00	39.83	21.16
T_{10}- Imazethapyr 10%SL+ 1 hoeing at 45 DAS	31.16	34.83	16.50
F-test	S	S	S
S.E. (±)	2.33	2.44	1.65
C.D. (P=0.05)	4.91	5.13	3.48

kg ha^{-1} at 2 DAS + one hoeing at 45 DAS were found to be statistically at par to that obtained in the treatment T_8 and the values were found to be significantly higher than all other weed management treatments tried. The probable reasons for obtaining highest weed control efficiency under treatment T_8 might be due to lesser weed competition faced by groundnut crop, as pre-emergence application of pendimethalin resulted in better weed management during initial stages of the crop growth and the later growth of weeds was checked one hoeing at 45 DAS. The results are in close agreement with the findings of Attarde *et al.* (2001) and Rao *et al.* (2011).

Effect weed management treatments on groundnut:

Number of branches :

A critical review of the Table 3 clearly shows that the highest number of branches was recorded under weed free plot (T_2) and the lowest was recorded in the treatment T_1-control. At 30 DAS, among the various weed management treatments tried, the highest number of branches were recorded under treatment T_6 -oxyfluorfen 23.5 EC+ 1 hoeing at 45 DAS and the values were found to be significantly higher than all other treatments. At 60 and 90 DAS, the highest number of branches were recorded under treatment T_8-pendimethalin @ 1 kg ha^{-1} at 2 DAS + 1 hoeing at 45DAS. Although the values obtained in the treatment T_4-two hoeing at 21 and 45 DAS, T_6 -oxyfluorfen 23.5 EC at 2 DAS + 1 hoeing at 45 DAS and T_{10}-imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS + 45 DAS were found to be statistically at par to that obtained in the treatment T_8 and the values were found to be significantly higher than all other weed management treatments.

The probable reasons for obtaining highest number of branches under treatment T_8 -pendimethalin @ 1 kg ha^{-1} ha at 2 DAS + 1 hoeing at 45DAS might be due to lesser weed competition faced by groundnut crop as pre-emergence application of pendimethalin resulted in better weed management during initial stages of the crop growth and the later growth of weeds was checked by hoeing, as also depicted in the highest weed control efficiency observed under the same treatment. These findings are similar with Sonwalkar and Londhe (2011); Priya *et al.* (2013) and Jat *et al.* (2011).

Plant dry weight :

A perusal of the Table 3 clearly shows that the highest plant dry weight accumulation was recorded under the weed free treatment (T_2) and the lowest was recorded in the treatment weed (T_1). At 30 DAS, among the various weed management treatments tried, the highest plant dry weight accumulation was recorded under treatments T_6 -oxyfluorfen 23.5 EC + 1 hoeing at 45 DAS and T_9-imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS and the values were found to be significantly higher than all other treatments. At 60 and 90 DAS, the highest plant dry weight accumulation was recorded under treatment T_8-pendimethalin @ 1 kg ha^{-1} at 2 DAS + 1 hoeing at 45DAS. Although the values obtained in the treatment T_4-Two control hoeing at 21 and 45 DAS, T_6 -oxyfluorfen 23.5 EC at 2 DAS + 1 hoeing at 45 DAS and T_{10}-imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS + 45 DAS were found to be statistically at par to that obtained in the treatment T_8 at 40 DAS and

Table 2 : Weed control efficiency of different weed control methods in groundnut at different intervals

Treatments	Weed dry matter weight (g/0.25 m^2)			Weed control efficiency (%)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1-Weedy check	50.91	62.63	42.41	-	-	-
T_2-Weed free	-	-	-	100	100	100
T_3- One hoeing at 21 DAS	13.95	20.85	16.51	72.54	66.6	61
T_4- Two hoeing at 21 and 45 DAS	13.89	15.26	10.43	72.56	75.62	75.38
T_5- Oxyfluorfen 23.5 EC @ 0.2 kg ha^{-1} at 2 DAS	13.37	18.97	14.59	72.64	69.29	65.50
T_6- Oxyfluorfen 23.5 EC + 1 hoeing at 45 DAS	14.07	15.95	10.85	72.24	74.51	74.38
T_7- Pendimethalin 30 EC @ 1 kg ha^{-1} at 2 DAS	11.02	16.96	14.65	78.30	72.81	66.03
T_8- Pendimethalin 30EC + 1 hoeing at 45 DAS	10.71	12.39	9.50	78.82	80.15	77.52
T_9- Imazethapyr 10% SL @ 100g ha^{-1} at 14 DAS	13.48	19.73	15.00	73.43	68.44	64.58
T_{10}- Imazethapyr 10% SL+ 1 hoeing at 45 DAS	13.99	15.97	11.77	72.54	74.53	72.23
F Test	S	S	S	S	S	S
S E. (±)	1.13	1.15	0.78	1.40	1.42	1.55
C.D. (P=0.05)	2.37	2.41	1.64	2.95	3.26	3.26

the values were found to be significantly higher than all other weed management treatments.

The probable reasons for obtaining higher plant dry weight accumulation under treatment T_8-pendimethalin @ 1 kg ha^{-1} at 2 DAS + 1 hoeing at 45DAS might be due to lesser weed competition faced by groundnut crop with pre-emergence application of pendimethalin which resulted in better weed management during initial stages of the crop growth and the later growth of weeds was checked by hoeing, as also depicted in the highest weed control efficiency observed under the same treatment. Similar results were also reported by Datta *et al*. (2005).

Number of pods :

From the Table 3 it is revealed that the highest number of pods per plant (23.06) was recorded under treatment T_2 (weed free) and lowest (9.66) in the treatment T_1-Control. Amongst the weed management treatments tried the highest number of pods (22.13) per plant was recorded under treatment T_8-pendimethalin @ 1 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS. Although the values obtained under treatment T_4-two hoeing at 21 and 45 DAS, T_6-oxyfluorfen @ 0.2 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS and T_{10}-imazethapyr 10 per cent SL @ 100 g ha^{-1} at 14 DAS + one hoeing at 45 DAS was found to be statistically at par to that obtained in the treatment T_8 and the values were found to be significantly higher than that obtained under all other weed management treatments tried.

The probable reasons for obtaining the highest number of pods per plant under treatment T_8 might be due to lesser weed competition faced by groundnut crop

Table 3 : Effect of different weed control methods on yield attributes and yield of groundnut

Treatments	Number of branches at 90 DAS	Plant dry weight (g) at 90 DAS	No .of pods plant^{-1}	Shelling percentage (%)
T_1-Weedy check	7.80	35.17	9.66	73.15
T_2-Weed free	12.86	53.00	23.06	74.30
T_3- One hoeing at 21 DAS	9.60	45.30	16.86	74.20
T_4- Two hoeing at 21 and 45 DAS	11.40	49.29	21.33	75.55
T_5- Oxyfluorfen 23.5EC @ 0.2 kg ha^{-1} at 2 DAS	10.2	45.70	17.06	73.32
T_6- Oxyfluorfen 23.5EC + 1 hoeing at 45 DAS	11.26	48.06	21.20	74.15
T_7- Pendimethalin 30EC @ 1 kg ha^{-1} at 2 DAS	10.20	43.29	18.33	74.28
T_8- Pendimethalin 30EC + 1 hoeing at 45 DAS	11.80	50.22	22.13	75.21
T_9- Imazethapyr 10% SL @ 100 g ha^{-1} at 14 DAS	9.66	42.23	17.60	73.18
T_{10}- Imazethapyr 10% SL+ 1 hoeing at 45 DAS	11.26	47.75	20.86	74.37
F Test	S	S	S	NS
S.E. (±)	0.33	1.61	0.68	0.83
C.D. (P=0.05)	0.69	3.39	1.44	

NS=Non-significant

Table 4 : Effect of different weed control methods on yield attributes and yield of groundnut

Treatments	Pod yield (q ha^{-1})	Seed yield (q ha^{-1})	Oil content (%)	Benefit : cost ratio
T_1-Weedy check	12.10	09.08	47.10	1.35
T_2-Weed free	28.52	21.22	49.30	2.39
T_3- One hoeing at 21 DAS	21.00	15.71	47.45	2.18
T_4- Two hoeing at 21 and 45 DAS	26.10	19.84	49.45	2.59
T_5- Oxyfluorfen 23.5EC @ 0.2 kg ha^{-1} at 2 DAS	21.50	15.92	48.50	2.31
T_6- Oxyfluorfen 23.5EC + 1 hoeing at 45 DAS	25.65	19.15	48.85	2.62
T_7- Pendimethalin 30EC @ 1 kg ha^{-1} at 2 DAS	22.40	16.80	48.45	2.38
T_8- Pendimethalin 30EC+ 1 hoeing at 45 DAS	27.15	20.32	49.65	2.74
T_9- Imazethapyr 10% SL @ 100 g ha^{-1} ha at 14 DAS	20.60	15.23	47.66	2.23
T_{10}- Imazethapyr10% SL+ 1 hoeing at 45 DAS	24.10	18.12	48.71	2.49
F Test	S	S		
S.E. (±)	0.23	0.33		
C.D. (P=0.05)	0.50	0.70		

as pre-emergence application of pendimethalin resulted in better weed management during initial stages of crop growth and the later growth of weeds was checked by hoeing at 45 DAS as also depicted in the highest weed control efficiency observed under the same treatment. These results confirm the findings of Singh *et al*. (2005) and Chaitanya *et al.* (2013).

Shelling percentage :

A critical review of the Table 3 clearly shows that the effect of weed control methods on shelling percentage was found to be non-significant in case of shelling percentage. However, the maximum shelling (75.55%) percentage was recorded under the treatment T_4 -two hoeing at 21 and 45 DAS. The minimum shelling percentage was recorded under the treatment T_1-weedy check.

Pod yield (q ha^{-1}) :

The highest pod yield was recorded under treatment T_2-weed free (28.52 q ha^{-1}) and lowest in the treatment T_1-control (12.10 q ha^{-1}) (Table 4). Amongst the weed management treatments tried, highest pod yield was recorded under treatment T_8-Pendimethalin @ 1 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS and the values were found to be significantly higher than that obtained under all other weed management treatments tried.

The probable reasons for obtaining highest pod yield under treatment T_8 might be due to lesser weed competition faced by groundnut crop as pre-emergence application of pendimethalin resulted in better weed management during initial stages of crop growth and the later growth was checked by hoeing at 45 DAS as also depicted in the highest weed control efficiency observed under the same treatment. These results are in close agreement with the findings of Singh *et al*. (2005); Bhale *et al.* (2012) and Madhu *et al*. (2006).

Seed yield (q ha^{-1}) :

Effect of weed control methods on seed yield of groundnut was statistically significant. Weed free plot recorded highest seed yield (21.22 q ha^{-1}) (Table 4). Among the various weed management treatments tried, the significantly higher seed yield (20.32q ha^{-1}) was obtained under treatment T_8-pendimethalin 30EC @ 1 kg ha^{-1} at 2 DAS + 1 hoeing at 45 DAS which was followed by treatment T_4 in which two hoeing were practiced at 21 and 45 DAS. The lowest seed yield was obtained in weedy check treatment. These results confirm the findings of Madhu *et al*. (2006), Sonwalkar and Londhe (2011); Bhalerao *et al.* (2011) and Yadav *et al.* (2013).

Oil content (%) :

Oil content in groundnut was significantly influenced by different weed control methods. The observations on effect of weed management practices on the content of groundnut was recorded and is being presented in Table 4. A critical view of the table clearly shows that the maximum oil content (49.65%) was recorded under treatment T_8-pendimethalin 30 EC @ 1 kg ha^{-1} at 2 DAS + 1 hoeing at 45 DAS and lowest under weedy check treatment. The probable reasons for obtaining higher oil percentage under treatment T_8 might be due to lesser weed competition faced by groundnut crop as pre-emergence application of pendimethalin resulted in better weed management during initial stages of crop growth of weeds and the later growth was checked by hoeing at 45 DAS. Similar results were also reported by Madhu *et al*. (2006).

Benefit cost ratio :

The benefit cost of groundnut as influenced by the various weed management treatments is presented in the Table 4. Maximum benefit cost ratio (2.74) was obtained in the treatment T_8- pendimethalin @ 1 kg ha^{-1} at 2 DAS + one hoeing at 45 DAS because of higher gross return (Rs. 76,020 ha^{-1}) with lesser cost of cultivation (Rs. 28,845 ha^{-1}). Similar results were also obtained by Kamble *et al.* (2003) and Kumar *et al.* (2013).

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