Indian Journal of Agronomy **61** (2): 210–216 (June 2016)

Research Paper

Effect of weed-management practices on weed flora, soil micro-flora and yield of baby corn (*Zea mays*)

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Received : March 2015; Revised accepted : March 2016

ABSTRACT

A field experiment was carried out during the winter seasons of 2010–11 and 2011–12 at Jaguli, West Bengal, on sandy-clay loam soil, to study the effect of different weed-control methods on weed growth, soil-microbial populations and productivity of baby corn (*Zea mays* L.). Besides weed-free check, the higher yield of baby corn (1,464 kg/ha) was recorded with 2 hand-weeding done at 20 and 40 days after sowing (DAS) owing to significantly lower weed dry weight, higher weed-control efficiency (88.32%), lower weed index (4.63%) and increased nutrient uptake than the other treatments. This treatment was followed by straw mulch @ 10 t/ha and increased the yield by 68.98% over weedy check. Integrated weed-management practices like pre-emergence atrazine or metribuzin @ 1 kg/ha coupled with 1 hand-weeding at 30 DAS exhibited superiority to the respective atrazine or metribuzin @ 2 kg/ha alone. Straw-mulch treatment showed the maximum favourable effect on growth of non-symbiotic N-fixing and phosphate-solubilizing bacteria of soil. After the initial suppression, the adverse effect of herbicides on the bacterial population was recovered from 25 DAS. The maximum net returns (₹43,470/ha) were obtained with hand-weeding twice, but the highest benefit: cost ratio (2.43) was recorded under atrazine-treated plots.

Key words : Baby corn yield, Economics, Nutrient removal, Soil micro-flora, Weed-control efficiency, Weed management

Baby corn is a dehusked maize ear harvested within 2–3 days of silk emergence, but prior to fertilization. Due to its short duration, the crop can easily be fit in an intensive cropping system. Baby corn provides a viable option for crop diversification owing to its multi-uses, such as vegetable for delicious human food, green fodder for quality livestock feed, raw material for canning and pickling food-processing industries, and enhancing profitability particularly in peri-urban areas (Sobhana *et al*., 2012). It also offers huge export potential and revenue generation.

Further, with ever-increasing use of fertilizer and irrigation water, weed management has assumed significant importance in modern intensive farming, as the total loss of crop yield with increasing cost of cultivation causes a greater economic loss to farmers (Arvadiya *et al*., 2012). The extent of yield loss due to weeds primarily depends on the composition of weed flora, period of crop-weed competition and its intensity. Weeds reduce crop yield by competing for light, water, nutrients and carbondioxide, interfere with harvesting and increase the cost involved in crop production. The worldwide yield losses in maize due to weeds are estimated to be around 37% (Oerke and Dehne, 2004).

Baby corn, being an exhaustive feeder, is generally fertilized heavily and spaced widely. Both these attract weed infestation that results in drastic reduction in crop yield. Moreover, slow crop growth at early stages during the winter season along with frequent irrigation causes the season-long weed infestation and yield reduction by 44% in baby corn (Mandal *et al*., 2004). Though baby corn is becoming popular in India, the systematic development of agro-techniques especially proper weed-management strategies is equally important to achieve higher production in a specific agro-climatic situation. However, application of pre-emergence and post-emergence herbicides had adverse effect on soil microbial population initially just after their application. Sebiomo *et al*. (2011) reported significantly higher soil bacterial populations in the control plots than the herbicides treated soils.

Considering the agricultural importance, the work done on the influence of weed management in baby corn growth

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and soil micro-flora is scanty. Therefore, the present experiment was planned to study the effect of different weed-control measures on weed flora, soil micro-flora and productivity of winter baby corn under irrigated situation.

MATERIALS AND METHODS

The field experiment was carried out during the winter seasons of 2010–11 and 2011–12 at Instructional Farm of Bidhan Chandra Krishi Viswavidyalaya, Jaguli, West Bengal (22.1° N', 89.2° E' and 9.75 m above mean sea-level). The soil was sandy clay loam with organic carbon 0.59%, available N 173 kg/ha, available P 13.70 kg/ha, available K 236 kg/ha and soil *p*H 6.8. Eight weed-management practices, viz. atrazine @ 2 kg/ha as pre-emergence, metribuzin @ 2 kg/ha as pre-emergence, paddy straw mulch @ 10 t/ha, hand-weeding (HW) twice at 20 and 40 DAS, atrazine @ 1 kg/ha as pre-emergence + HW at 30 DAS, metribuzin @ 1 kg/ha as pre-emergence + HW at 30 DAS, weed-free check and weedy check, were evaluated in a randomized block design with 3 replications. The experimental plots were 4.5 m wide × 3 m long. The land preparation was done by 2 ploughings (including operation with disc plough and cultivator) followed by 1 laddering to make fine seedbed. Sowing was done manually. The baby corn variety 'Early Composite' was used for sowing. Seeds were treated with fungicide Bavistin @ 3 g/kg seeds and sown in lines at a spacing of 45 cm × 30 cm during mid-November in each year. The crop was fertilized with recommended dose of fertilizers like 120 : 60 : 40 kg N : P_2O_5 : K_2O/ha. The shallow furrows were opened in each plot where the entire quantities of phosphorus and potassium and half dose of nitrogen were applied manually before sowing of baby corn in both the years. The remaining N was top-dressed after irrigation at 30 days after sowing (DAS). Recommended package of recommended practices was adopted to maintain the crop. The required quantity of all the herbicides was measured accurately and applied uniformly as pre-emergence at 3 DAS, using knapsack sprayer fitted with flat-fan nozzle in 500 *l* of water/ha as per treatment. Weedy-check plots remained infested with native population of weeds till harvest. Besides, a pre-sowing irrigation for uniform germination of seeds, the crop received 3 post-sowing irrigations at all critical stages of growth like seedling, knee-height and tasseling stages, respectively, during both the years. The treatment with paddy-straw mulch was applied after germination and establishment of seedlings in the field. The intercultural operation 'de-tesseling' was done in a regular manner. Harvesting was done by simply picking the young cobs just after emergence of silk. There was no much variation in weather during the cropping period in both the years. The rainfall in 2 crop seasons was 4.9 mm in 2010–11 and 6.1 mm in 2011–12. In general, weather conditions were favourable for plant growth and no severe pest and diseases noticed during both the years.

Observations on weed population and dry weight of weed were recorded at 25 DAS, 50 DAS and at harvesting stage from pre-marked quadrant of 1.0 m^2 area, placed randomly at 2 spots in each plot. Data on weed density and dry weight were subjected to square-root transformation ($\sqrt{x+0.5}$) to normalize the distribution. Weed indices like weed-control efficiency and weed index were worked out to assess the efficiency of different weed-control treatments. The phyto-toxicity on crop due to herbicides was recorded at 14 and 21 days after herbicides application (DAHA), using 0–10 scale. The data on growth parameters and yield attributes were recorded from 5 random plants in each plot. The concentrations of N, P and K were analyzed in crop and weeds and their uptake was calculated. The economics was calculated based on prevailing market prices of inputs and outputs.

The enumeration of the soil microbial population was done on agar plates containing appropriate media following serial dilution technique and pour plate method (Pramer and Schmidt, 1966). Jensen's agar medium was used for counting aerobic non-symbiotic nitrogen-fixing bacteria (NFB) and for that of phosphate-solubilizing bacteria (PSB), Pikovskaia's agar medium was used. The *p*H of the medium was maintained at 7.0 for NFB and 7.4 for PSB, and the medium was sterilized at 15 lbs stream pressure for 20 minutes. Plates were incubated at 30°C. The counts were taken at 5th day of incubation as the number of cells/gram of soil.

The treatment effects in both years were same, so pooled analysis of data was made. The data recorded were statistically analyzed using SAS 9.2 programme. The mean differences were computed at 5% level of significance.

RESULTS AND DISCUSSION

Weed flora

The major weed flora in the field comprised 30.1% grassy weeds (*Cynodon dactylon* L., *Echinochloa* sp. L. and *Digitaria sanguinalis* L.); 11.9% of sedges (*Cyperus rotundus* L.); and 57.8% of broad-leaf weeds (*Digera arvensis* L., *Amaranthus viridis* L., *Portulaca oleracea* L., *Alternenthara sessilis* L. and *Melilotus alba*).

Effect on weeds

Weed population and weed dry weight reflect the growth potential of the weeds and are the important indicators of its competition ability with the crops. The weed population and dry weight of grass, sedge and broad-leaf weeds per unit area were significantly reduced under vari-

Table 1. Weed density, weed dry weight, weed-control efficiency and weed-control index and nutrients uptake by weeds in baby corn as influenced by various weed-management practices (pooled data of 2 years)

Treatment	Total weed density (Nos./m^2)			Weed dry weight (g/m^2)			WCE (%)	WI (%)	Nutrient removal by weeds (kg/ha)		
	25 DAS	50 DAS	Harvest	25 DAS	50 DAS	Harvest			N	P	K
Atrazine @ 2 kg/ha	6.39 (40.40)	8.73 (75.56)	10.94 (119.28)	2.41 (5.28)	3.69 (13.08)	5.21 (26.65)	54.83	16.68	14.87	5.75	12.57
Metribuzin @ 2 kg/ha	7.17 (50.87)	9.84 (96.37)	12.25 (149.66)	2.88 (7.79)	4.22 (17.26)	5.81 (33.30)	43.54	20.0	16.99	6.61	14.43
Paddy straw mulch @ 10 t/ha	3.83 (14.14)	4.54 (20.09)	6.12 (36.93)	1.56 (1.94)	1.99 (3.46)	3.41 (11.15)	81.10	6.52	8.66	3.99	6.92
Hand-weeding (HW) at 20 and 40 DAS	3.52 (11.86)	3.73 (13.36)	5.11 (25.61)	1.31 (1.23)	1.62 (2.13)	2.72 (6.89)	88.32	4.63	6.53	3.14	5.11
Atrazine @ 1 kg/ha + HW at 30 DAS	8.95 (79.65)	5.44 (29.06)	7.72 (59.04)	3.37 (10.82)	2.77 (7.17)	4.01 (15.52)	73.69	9.84	10.74	4.37	8.76
Metribuzin @ 1 kg/ha + HW at 30 DAS	9.61 (91.75)	6.21 (38.07)	8.71 (75.33)	3.68 (13.04)	3.28 (10.27)	4.58 (20.46)	65.31	12.90	12.65	4.89	10.61
Weed-free	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	100.0	0.00	4.23	2.16	3.09
Weedy check	11.52 (132.17)	13.87 (191.75)	16.53 (272.49)	4.57 (20.38)	5.60 (30.80)	7.72 (58.99)	0.00	40.26	21.75	14.54	20.89
SEm±	0.22	0.25	0.31	0.10	0.12	0.17			0.65	0.25	0.52
CD (P=0.05)	0.63	0.72	0.89	0.28	0.34	0.48			1.89	0.72	1.53

Figure in parentheses refers to original values and outside values subject to square root transformation ($\sqrt{x+0.5}$); WCE, Weed-control efficiency; WI, weed index; DAS, days after sowing

ous weed- management treatments compared to weedy check (Table 1). The highest reduction of weed density and dry weight of weeds was recorded in completely weed-free plots, followed by hand-weeding twice at 20 and 40 DAS at all the stages of crop growth. An initial mulching with paddy straw @ 10 t/ha had also a smothering effect on weeds and thereby, exhibited lower emergence of weeds. At harvesting, the hand-weeding twice resulted in 69.1% less weed population and 64.8% low weed dry weight compared to the weedy check. The higher weed-control efficiency and lower weed competition index under hand-weeding twice indicated its superiority to the other treatments. This was due to effective control of all the categories of weed that emerged at early and later stages of crop growth and ultimately maintained almost weed-free environment to baby corn crop. This finding confirm the result of Arvadiya *et al*. (2012). The next higher weed control efficiency and lower weed-competition index was observed under straw-mulch treatment might be owing to its effectiveness to suppress the growth of existing as well as germinating weed flora during the crop period. However, increased dose of atrazine or metribuzin applied @ 2 kg/ha each did not exhibit higher weed-control efficiency, but lower the concentration of these herbicides (atrazine or metribuzin @ 1 kg /ha) coupled with 1 hand-weeding at 30 DAS was more effective in controlling the weeds. The pre-emergence herbicide treatment alone (either atrazine or metribuzin @ 2 kg /ha) was not superior to that of the respective integrated weed-management practices because the application of herbicide alone might have reduced the population and dry-matter accumulation of weeds at the early phase of crop growth, but at the later stage more weeds per unit area had emerged with the crop. This was probably due to volatile nature and low persistence of these herbicides in the soil that reduced their activity for longer period. However, the higher weed-control efficiency and less competition from weeds under atrazine @ 1 kg /ha + HW at 30 DAS or metribuzin @ 1 kg/ha + HW at 30 DAS might be owing to the effectiveness of herbicide in killing the weeds initially followed by eradication of the second flash of weeds by 1 hand-weeding at 30 DAS in a better way. Tripathi *et al.* (2010) also reported the effectiveness of herbicides in integration with manual weeding to check the weed growth. Among these herbicides, atrazine either alone or integrated with HW showed its superiority by lowering the density and dry weight of grass, sedge and broad-leaf weeds as compared to that of metribuzine at all the stages of crop growth. The better ability of atrazine might have attributed to control of complex weed flora effectively due to its effect on wide spectrum of weed species. On the contrary, the lowest weed-control efficacy of metribuzin was due to escape of some weed species. The ability of atrazine to control weeds of maize in an effective way was revealed by Norsworthy and Frederick (2005). Because of having no weed-control measure, the weedy-check plots were severely infested with weeds indicating the highest weed growth and weed biomass at all dates of observations.

Effect on soil micro-flora

The experimental results revealed that herbicidal treatments exerted a significant detrimental effect on aerobic non-symbiotic N-fixing bacteria and P-solubilizing bacteria and resulted in reduction of microbial count in all soil samples collected at 25 DAS (Table 2). Paddy straw mulch @ 10 t/ha treatment plots significantly increased the population of non-symbiotic N fixing from 45.68×10^4 to 118.15×10^4 and phosphate-solubilizing bacteria from 31.74×10^4 to $1,125.85 \times 10^4$ from 25 DAS to harvesting of the crop (Choudhari *et al*., 2010). But the harmful effect of herbicides did not last long and that was reflected through the stimulation on bacterial population in the rhizosphere soil thereafter (Sebiomo *et al*., 2011). Initial suppression of microbial population might be due to toxic

Table 2. Effect of weed-management practices on population of non-symbiotic nitrogen-fixing and phosphate-solubilizing bacteria in the rhizosphere soil of baby corn (pooled data of 2 years)

Treatment	Non-symbiotic N-fixing bacteria (CFU × 10^4/g of soil)			Phosphate solubilizing bacteria (CFU × 10^4/g of soil)		
	25 DAS	50 DAS	Harvest	25 DAS	50 DAS	Harvest
Atrazine @ 2 kg/ha	23.49	51.57	90.18	10.49	36.66	68.17
Metribuzin @ 2 kg/ha	21.44	46.92	84.47	8.88	27.57	59.80
Paddy straw mulch @ 10 t/ha	45.68	77.30	118.15	31.74	70.52	125.85
Hand-weeding (HW) at 20 and 40 DAS	42.75	62.98	104.28	25.74	58.12	99.26
Atrazine @ 1 kg/ha + HW at 30 DAS	29.39	58.48	100.45	14.41	48.98	83.56
Metribuzin @ 1 kg/ha + HW at 30 DAS	26.11	53.91	96.15	13.70	42.59	74.82
Weed-free	43.23	66.38	109.03	27.47	63.06	111.71
Weedy check	34.45	36.67	52.67	19.18	16.26	28.62
SEm±	0.73	1.44	2.01	0.51	1.02	1.65
CD (P=0.05)	2.11	4.17	5.79	1.49	3.01	4.78

DAS, days after sowing; CFU, colony forming unit

Table 3. Growth and yield attributes and phyto-toxicity in baby corn as influenced by weed-management practices (pooled data of 2 years)

Treatment	Plant height at harvest (cm)	LAI at 60 DAS	Dry-matter accumulation (g/m^2)	CGR at 40–60 DAS (g/m^2/day)	Baby corn cob			Phyto-toxicity	
					Nos./ plant	Weight (g)	Length (cm)	Girth (cm)	Ratings (0–10 scale) at 21 DAHA
Atrazine @ 2 kg/ha	148.11	3.48	369.50	7.20	1.62	6.25	6.04	1.14	2.0
Metribuzin @ 2 kg/ha	141.42	3.39	345.25	6.68	1.51	5.99	5.83	1.10	4.0
Paddy straw mulch @ 10 t/ ha	161.44	3.61	478.85	9.70	2.16	6.52	6.37	1.25	0.0
Hand weeding (HW) at 20 and 40 DAS	168.43	3.66	494.25	10.10	2.29	6.63	6.45	1.32	0.0
Atrazine @ 1 kg/ha + HW at 30 DAS	159.31	3.57	435.75	8.45	1.84	6.41	6.23	1.22	0.0
Metribuzin @ 1 kg/ha + HW at 30 DAS	153.37	3.53	421.75	8.18	1.71	6.34	6.17	1.18	0.0
Weed free	172.59	3.69	508.87	10.92	2.35	6.74	6.52	1.35	0.0
Weedy check	135.45	2.89	292.60	5.72	1.39	5.81	5.61	1.08	0.0
SEm±	1.29	0.007	4.07	0.07	0.01	0.03	0.02	0.008	-
CD (P=0.05)	3.86	0.02	11.54	0.20	0.03	0.08	0.05	0.02	-

DAS, days after sowing; LAI, leaf-area index; CGR, crop-growth rate; DAHA, days after herbicide application effect of herbicides in soil environment. The effect was more pronounced in pre-emergence application of metribuzin at higher dose of 2 kg/ha compared to that of atrazine. In case of both the bacteria, the pattern of decline in population and subsequent recovery followed the similar fashion in both years. However, the recovery rate was faster in atrazine than metribuzine with respect to bacterial population. Under the straw-mulch treatment, the increase in the microbial population continued significantly up to height level and this was due to the conservation of optimum moisture in addition to greater availability of energy and nutrients (carbon and nitrogen) for higher rate of mineralization of organic substances in soil at an elevated temperature. Similar trend of microbial proliferation was observed in weed-free and hand-weeding twice plots due to conserve nutrients for the growth and multiplication of these microorganisms. However, the bacterial population did not enhance profusely in weedy-check plots, which might be due to the harmful effect of root exudates secreted by complex weed flora in rhizosphere soil.

Effect on crop growth and yield

The results pertaining to growth attributes of baby corn revealed that among the different weed-management practices, the weedy check, as expected, showed the minimum plant height, LAI, dry-matter accumulation and crop-growth rate due to severe competition of weeds with baby corn for growth resources such as plant nutrients, soil moisture etc. throughout the life span of the crop (Table 3). The crop did not grow well as weeds robbed up the growth resources. However, the maximum values of growth attributes were recorded under weed-free check, followed by the hand-weeding twice at 20 and 40 DAS. In this treatment, the crop did not face much competition with weeds for growth resources at any time during its life, resulting in vigorous growth of the crop. The higher LAI under twice hand-weeding treatment might be associated with greater photosynthetic ability of plants, which in turn increased dry-matter accumulation and faster crop-growth rate. This treatment showed 76.6% higher growth rate than weedy check during the grand growth period (40–60 DAS). Moreover, the integrated weed-management with pre-emergence application of either atrazine or metribuzin coupled with 1 hand-weeding at 30 DAS performed better than the respective herbicide alone. This might be due to herbicide application coupled with hand-weeding provided better weed-control ability and thereby, rendering the crop plants to make the better utilization of available underground and above-ground resources and to produce better growth attributes. These observations are in agreement with Prasad *et al*. (2008).

Hand-weeding twice at 20 and 40 DAS proved its superiority by producing significantly higher values of number of cobs/plant, weight/cob, length/cob and girth/cob compared to the other treatments, except weed-free check (Table 3). This treatment produced 1,464 kg/ha cob and 38.41 t/ha green fodder yields, which were 65.98% higher corn yield over weedy check (Table 4). This could be attributed to least competition offered by weeds for nutrients and moisture at crucial growth stages under the 2 time hand-weeding, which ultimately improved all yield attributes besides increased rate of N, P and K uptake cumulatively helped the crop plants to produce more surface area for high photosynthetic rate as well as maximum translocation of photosynthates from source to sink. Because of the synergist effect among the yield attributes,

Table 4. Effect of weed-management practices on nutrient uptake, yield and economics of baby corn (pooled data of 2 years)

Treatment	Nutrient uptake by crop (kg/ha)			Baby corn yield (t/ ha)			Green fodder yield (t/ha)	Cost of cultivation (× 10^3 ₹/ha)	Net returns (× 10^3 ₹/ha)	Benefit: cost ratio
	N	P	K	2010-11	2011-2012	Mean				
Atrazine @ 2 kg/ha	67.5	15.0	52.4	1.24	1.28	1.26	33.11	24.8	35.4	2.43
Metribuzin @ 2 kg/ha	63.2	14.1	50.1	1.19	1.22	1.21	32.74	24.6	33.5	2.36
Paddy straw mulch @ 10 t/ha	88.8	21.1	61.2	1.42	1.45	1.44	37.60	28.7	39.9	2.39
Hand-weeding (HW) at 20 and 40 DAS	95.7	22.4	65.8	1.45	1.48	1.46	38.41	29.6	43.4	2.37
Atrazine @ 1 kg/ha + HW at 30 DAS	79.8	19.0	56.9	1.35	1.38	1.36	35.31	27.2	36.6	2.34
Metribuzin @ 1 kg/ha + HW at 30 DAS	73.3	17.1	54.3	1.30	1.33	1.32	35.13	27.1	36.0	2.32
Weed-free	108.6	24.5	69.7	1.52	1.55	1.54	39.26	37.3	35.7	1.95
Weedy check	57.7	12.7	46.2	0.86	0.90	0.88	23.54	21.2	21.1	1.99
SEm±	1.11	0.41	0.76	0.01	0.01	0.01	0.04	-	-	-
CD (P=0.05)	3.22	1.16	2.19	0.02	0.02	0.02	0.12	-	-	-

Cost of cultivation: ₹21,215/ha; cost of treatments: atrazine, ₹900/kg; metribuzin, ₹1,200/kg; paddy straw; ₹750/t; labour, 140/man-days; price of baby corn, ₹40/kg and green fodder, ₹300/t they benefited each other. These findings are similar to Singh *et al*. (2010). Ultimately the pronouncing effect of all said growth parameters reflected on green cob and fodder yields of baby corn.

The straw-mulch treatment also improved the yield of baby corn and found as the next best treatment which showed 62.69% higher baby corn yield and 59.72% green fodder yield than weedy check (Table 4). Between the herbicidal treatments, the superiority of pre-emergence application of atrazine alone in giving 4.22% higher baby corn yield over metribuzin alone might be owing to the effective and broad-spectrum weed-controlling ability of atrazine and thereby, reducing the crop-weed competition. However, the pre-emergence application of atrazine or metribuzin followed by hand-weeding at 30 DAS resulted in 8.33% and 9.02% higher cob yields corresponding to the respective pre-emergent herbicide alone. Significantly the lowest value of cob yield and fodder yield was recorded with weedy-check treatment. Further, both the herbicides at higher concentration @ 2 kg/ha exhibited their phyto-toxicity symptoms to plants till 21 days after spraying and the crop was recovered during later growth period (Table 3) .

Nutrient removal by weeds and crop

The N, P and K removal by weeds was significantly influenced by various weed-management practices (Table 1). Nutrient removal by weeds was the lowest in weed-free plot, followed by hand weeding twice at 20 and 40 DAS. However, the highest removal of N, P and K was recorded in weedy check plot. Therefore, it was well augmented that weeds should be controlled at early stage of crop growth. Any delay in weed-control might have resulted in robbing off nutrients by weeds and depriving the crop of its share (Hanwen *et al*., 2010). Weed could be controlled effectively and economically by 2 hand-weedings at 20 and 40 DAS, reflecting lower nutrient removal by weeds. Pre-emergence herbicides mainly reduced weeds in early stages of babycorn and weed emergence at later stage did not control well. Therefore, a combination of herbicides and 1 hand-weeding showed lower uptake of nutrients by weeds than that of herbicides alone.

All the weed-control practices resulted in significantly higher uptake of plant nutrients over the weedy check (Table 4). Weed-free treatment showed the highest uptake of nutrients, followed by hand-weeding twice. Two hand-weedings at 20 and 40 DAS recorded 65.7% increase in N uptake, 75.5% increase in P uptake and 42.4% increase in K uptake over the weedy check. Favourable crop-growth conditions and lower crop-weed competition which resulted in higher babycorn and green fodder yields owing to the higher nutrient uptake by the crop. While the integrated weed management having atrazine or metribuzin @ 1 kg/ha along with hand-weeding at 30 DAS registered higher N, P and K uptake by crop than that of respective herbicide applied alone, this might be due to the phytotoxicity on crop under higher doses of herbicides.

Economics

From the economic point of view, high profitable green cob and fodder yields of winter baby corn was obtained under weed-management practices. All weed-control treatments recorded considerably higher returns over weedy check (Table 4). The maximum net return was realized with hand-weeding twice at 20 and 40 DAS; however, the highest benefit: cost ratio (2.43) with atrazine @ 2 kg/ha. This was owing to higher labour cost incurred in hand-weeding treatment. The lowest benefit: cost ratio (1.95) was noted under weed-free check.

It was concluded that hand-weeding twice at 20 and 40 DAS is an effective weed management practice in reducing weed growth, producing maximum yield and higher net returns in winter season baby corn.

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