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Weed dynamics of Baby Corn (*Zea mays* L.) as influenced by different weed management practices under the temperate conditions of Kashmir valley

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ABSTRACT
A field experiment entitled weed dynamics of baby corn (Zea mays L.) as influenced by different weed management practices under the temperate conditions of Kashmir valley was conducted at Mountain Livestock Research Institute (MLRI), Manasbal, (SKUAST-K) during kharif2014. The experiment comprising of 11 treatments [Farmers practice (W_1); Earthing up and weeding at 30 and 45 DAS (W_2); Atrazine @ 1.5 kg a.iha^{-1}pre-emergence at 1 DAS (W_3); atrazine @ 1.5 kg a.iha^{-1} early post-emergence at 10 DAS (W_4); straw mulch (paddy straw) at 1DAS (W_5); straw mulch (brown sarson) at 1DAS (W_6); polyethylene mulch (black) at 1DAS (W_7); polyethylene mulch (white) at 1DAS (W_8); saw mulch at 1DAS (W_9); weedy check (W_{10}) and weed free (W_{11})] was laid out in a randomized complete block design with three replications. Significant variation in growth and yield was recorded among the various treatments tested. Weed management practices recorded marked variation in the different weed parameters. W_{11} recorded significantly lowest weed density, dry matter accumulation and weed index among all the treatments whereas, highest values of these parameters was recorded in the W_{10} treatment. Highest and lowest values of weed control efficiency were recorded in W_{11} and W_{10} treatments, respectively. The highest net profit (Rs. 91760) and B:Cratio (1.54) was recorded for the treatment W_2 and was closely followed by treatment W_3,whereas, the lowest net profit (Rs. 45802) and B:C ratio (0.44) was recorded for treatment W_8.
Key words*: Weed, profit, baby corn, atrazine, management, kharif*

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INTRODUCTION

In India, maize (Zea mays L.) is grown on an area of 9.43 mha, with production and productivity of 24.35 mt and 2583 kg/ha, respectively (GOI, 2014). Maize has been classified in different types according to its use and/or starch content viz., Flour corn (*Zea mays* var. Amylacea) Popcorn (*Zea mays* var. Everta) Dent corn (*Zea mays* var. Indentata) Flint corn (*Zea mays* var. Indurata) Sweet corn (*Zea mays* var. Saccharata) Waxy corn (*Zea mays* var. Ceratina) Pod corn (*Zea mays* var. Tunicate) and Baby corn (*Zea mays* L.) [2].

Baby corn (*Zea mays* L.) refers to the whole, entirely edible cobs of immature corn harvested just before fertilization at 2-3 cm long silk emergence stage [2]. Baby corn is a delicious and nutritive vegetable and it is consumed as a natural food. It is very tasty, sweet and easy to consume because of its tenderness and sweetness with good nutritive value. Due to changing food preferences in Indian life style, the urban population is switching over to new food items; the 'Baby corn' is a new addition to Indian foods. Being a short duration crop, it easily fits in an intensive cropping system and in addition to baby cob it provides delicious green fodder to cattle [3].

Weeds are perceived by the farming community as being the greatest cause of yield loss in maize crop. They create a severe crop weed competition and are competing for light, water, nutrients, space, carbon dioxide etc. and increasing the cost of production. Yield losses in the range of 50-60% occur owing to absence of appropriateness, untimely and uncontrolled weed growth in maize fields and therefore needing immediate attention. Manual weeding though very effective in controlling weeds, very often is cumbersome, labour intensive, expensive and time consuming [9]. The use of atrazine herbicide has yielded encouraging results in maize at national and international level. How this herbicide behaves with respect to weed growth and crop growth when applied at different stages of this crop needs to be studied. Different mulches can be exploited for weed control in this crop and the different resources lying with the farming community can be put to use depending upon their availability and suitability. Keeping in view the above facts, the study weed dynamics of baby corn (Zea mays L.) as influenced by different weed management practices under the temperate conditions of Kashmir valley was undertaken.

MATERIAL AND METHODS

The experiment was conducted at Mountain Livestock Research Institute (MLRI) Manasbal, SKUAST-Kashmir during *Kharif* 2014. The site is situated between 34.15°N and 74.40°E at an altitude of 1650 metres above mean sea level. Climatically the experimental site falls in temperate zone of north western Himalaya characterised by hot summers and very cold winters. The average annual precipitation is 944.6 mm (average of past 30 years) most of which is received from December to April in the form of snow and rains. It is evident from the data that mean maximum and minimum temperatures were 28.14°C and 12.88°C, respectively and the total precipitation amounted to 389.50 mm during crop growth period of 2014. The total number of sunshine hours recorded during the crop growth period was 144.36 hours and the mean maximum and minimum relative humidity were 79.30% and 53.00%, respectively during the crop growth period. The soil was clay loam in texture, high in organic carbon, low in available nitrogen, medium in available phosphorus and high in available potassium with neutral pH.

The experiment consisting of eleven treatments was laid out in a randomized complete block design with three replications and eleven treatments: Farmers practice (W_1), Earthing up and weeding at 30 DAS and 45 DAS (W_2), Atrazine @ 1.5 kg *a.i*ha^{-1} Pre-emergence at 1 DAS (W_3), Atrazine @ 1.5 kg *a.i*ha^{-1} Early Post-emergence at 10 DAS (W_4), Straw mulch (paddy straw) at 1DAS (W_5), Straw mulch (brown sarson) at 1DAS (W_6), Polyethylene mulch (black) at 1DAS (W_7), Polyethylene mulch (white) at 1DAS (W_8), Saw mulch at 1DAS (W_9), Weedy check (W_{10}) and Weed free (W_{11}). The variety HM-4 was used for the experiment. The gross plot size was 6 m × 3 m and net plot size was 5.40 m × 1.50 m.The major weeds associated with the crop were identified according to species during the crop growth. 1 m^{2}quadrant was randomly thrown in each plot at knee high, tasselling, and maturity stages. Weeds under the quadrant were carefully cut at ground level and total number of weeds m^{-2} was counted. The weed samples from 1 m^2 quadrat in each plot were counted species wise at different growth stages viz., knee high, tasselling, and maturity. These samples were oven dried at 60°C temperature to a constant weight and total dry matter accumulation of weeds m^{-2} was recorded and expressed in q ha^{-1}. At maize harvest, weed control efficiency (WCE) was calculated, using the weed dry matter weight per treatment on the basis of formula as [8]:

$$WCE\ (\%) = \frac{(DWC - DWT)}{DWC} \times 100$$

Where,
WCE = Weed Control Efficiency
DWC = Dry weight of weeds from control plot
DWT = Dry weight of weeds from treated plot
At maize harvest, weed index (WI) was calculated, using the formula:

$$WI\ (\%) = \frac{(X-Y)}{X} \times 100$$

Where,
X= yield from weed free plot and
Y= yield from treated plot

The samples were grounded and subsequently used for chemical analysis. The economic analysis was done on the basis of prevailing market prices of inputs and output from each treatment.

RESULT AND DISCUSSION

Weeds identified

The major weeds associated with the crop were *Cynodondactylon, Sorghum halepense, Poaannua, Portulacaoleracea, Convolvulus arvensis, Amaranthus* sp*., Chenopodium album* and*Cyperusrotundus*(Table 1)[1].

Weed density (No. m^{-2})

Data presented in Table 2 showed that weed density was significantly affected by different weed management practices. Weedy check treatment recorded highest weed density at knee high (76 m^{-2}), tasseling (99 m^{-2}) and harvesting stages (112 m^{-2}) and was followed by atrazine @ 1.5 kg *a.i* ha^{-1} Early post-emergence which recorded a value of 74 m^{-2}, 93 m^{-2} and 102 m^{-2} at knee high , tasseling and harvesting stages , atrazine @ 1.5 kg *a.i* ha^{-1}pre-emergence, paddy straw mulch, farmers practice, brown sarson mulch, white polyethylene mulch, black polyethylene mulch, earthing up and weeding at 30 DAS and 45 DAS, respectively, whereas the lowest weed density was recorded by weed free at knee high (0 m^{-2}), tasseling (0 m^{-2}) and harvesting stage (0 m^{-2}) . This might be due to the continuous removal of weeds under weed free treatment that resulted in lowest weed density. Lowest weed density resulted in reduced crop-weed competition, which helped the crop to grow better and resulted in less removal of nutrients by weeds. Among the different mulches black polyethylene mulch recorded the lowest weed density [4, 5, 8].

Dry matter accumulation of weeds

Dry matter accumulation of weeds was significantly affected by different weed management practices as depicted in Table 3. Weedy check treatment recorded highest dry matter accumulation at knee high (20.05 q ha^{-1}), tasseling (24.45 q ha^{-1}) and harvesting stages (27.94 q ha^{-1}) and was followed by atrazine @ 1.5 kg *a.i* ha^{-1} Early post-emergence which recorded a value of 16.44 q ha^{-1}, 19.27 q ha^{-1} and 23.81 q ha^{-1} at knee high, tasseling and harvesting stages, atrazine @ 1.5 kg *a.i* ha^{-1}pre-emergence, paddy straw mulch, farmers practice, brown sarson mulch, white polyethylene mulch, black polyethylene mulch, earthing up and weeding at 30 DAS and 45 DAS respectively, whereas the lowest dry matter accumulation was recorded by weed free at knee high (0 q ha^{-1}), tasseling (0 q ha^{-1}) and harvesting stage (0 q ha^{-1}). This might be attributed to the effective control of weeds under these treatments, which reflected in less number of weeds and ultimately lower weed biomass [4, 5, 8].

Table 1:Weed flora identified during the crop growth of baby corn (*Zea mays* L.)

	Scientific name	Family	Common name	Local name
Grassy weeds	*Cynodondactylon*	Graminae	Bermuda grass	*Dramoun*
	Sorghum halepense	Graminae	Johnson's grass	*Durhoma*
	Poaannua	Graminae	Annual blue grass	*Mahighass*
Non-grasses	*Portulacaoleracea*	Portulacacae	Common purslane	*Nunner*
	Convolvulus arvensis	Convolvulacae	Field bind weed	*Thrir*
	Amaranthusspp.	Amaranthacae	Pig weed	*Lisa*
	Chenopodium album	Chenopodiacae	Common lambsquarters	*Von palak*
Sedges	*Cyperusrotundus*	Cyperacae	Nut sedge	*Zab*

Table 2:Weed density (m^{-2}) in baby corn (*Zea mays* L.) at different stages of crop growth as influenced by different weed management practices

Growth stages Treatments	Knee high stage	Tasseling stage	Harvesting stage
Farmers practice	7.74 (59)	8.83 (77)	9.64 (92)
Earthing up and weeding	4.89 (23)	5.91 (34)	7.27 (52)
Atrazine @ 1.5 kg a.i ha^{-1} PE	8.36 (69)	9.43 (88)	9.89 (97)
Atrazine @1.5 kg a.i ha^{-1} Early PoE	8.65 (74)	9.69 (93)	10.14 (102)
Paddy straw mulch	7.87 (61)	8.94 (79)	9.48 (89)
Brown sarson mulch	7.54 (56)	8.65 (74)	9.32 (86)
Black polyethylene mulch	6.32 (39)	6.77 (45)	7.99 (63)
White polyethylene mulch	6.78 (45)	8.18 (66)	8.88 (78)
Saw mulch	7.27 (52)	8.42 (70)	9.10 (82)
Weedy check	8.77 (76)	9.99 (99)	10.62 (112)
Weed free	2.03 (0.00)	3.05 (0.00)	4.23 (0.00)
SEm±	0.03	0.02	0.02
C.D ($p \leq 0.05$)	0.11	0.08	0.06

* Original values are in parenthesis

** Data subjected to square root transformation

Table 3:Dry matter accumulation of weeds (q ha^{-1}) in baby corn (*Zea mays* L.) at different stages of crop growth as influenced by different weed management practices

Growth stages Treatments	Knee high stage	Tasseling stage	Harvesting stage
Farmers practice	14.66	17.60	21.82
Earthing up and weeding	10.38	14.49	17.07
Atrazine @ 1.5 kg a.i ha^{-1} PE	15.49	18.93	22.75
Atrazine @1.5 kg a.i ha^{-1} Early PoE	16.44	19.27	23.81
Paddy straw mulch	12.27	15.93	19.90
Brown sarson mulch	11.49	15.32	18.62
Black polyethylene mulch	11.11	14.94	17.93
White polyethylene mulch	11.16	15.77	17.95
Saw mulch	13.82	16.49	20.88
Weedy check	20.05	24.45	27.94
Weed free	0.00	0.00	0.00
SEm±	0.11	0.11	0.16
C.D (p≤0.05)	0.33	0.33	0.49

Table 4:Effect of weed management practices on weed control efficiency (%) and weed index in baby corn (*Zea mays* L.) at different stages of crop growth

Growth stages Treatments	Knee high stage	Tasseling stage	Harvesting stage	Weed Index
Farmers practice	5.05 (18.76)	0.61 (21.95)	5.87 (19.00)	3.79 (12.25)
Earthing up and weeding	6.93 (42.53)	0.19 (35.79)	6.14 (36.68)	12.17 (4.02)
Atrazine @ 1.5 kg a.i ha^{-1} PE	3.63 (14.11)	0.27 (16.06)	3.35 (15.57)	4.42 (16.48)
Atrazine @1.5 kg a.i ha^{-1} Early PoE	5.00 (8.86)	1.90 (14.54)	6.59 (11.61)	3.76 (17.16)
Paddy straw mulch	5.31 (32.12)	0.46 (29.38)	4.47 (26.23)	3.73 (5.63)
Brown sarson mulch	5.99 (36.35)	0.13 (32.11)	5.21 (30.89)	3.76 (6.15)
Black polyethylene mulch	6.44 (38.96)	0.81 (33.79)	4.07 (33.48)	3.39 (4.85)
White polyethylene mulch	5.49 (38.55)	0.17 (30.12)	5.65 (33.40)	3.14 (5.91)
Saw mulch	5.66 (23.43)	0.72 (26.93)	6.54 (22.49)	3.12 (11.26)
Weedy check	2.31 (0.00)	1.31 (0.00)	4.85 (0.00)	4.79 (38.77)
Weed free	7.21 (100.00)	0.26 (100.00)	7.27 (100.00)	1.03 (0.00)
SEm±	1.02	0.85	0.37)	0.02
C.D (p≤0.05)	NS	NS	1.11	0.07

* Original values are in parenthesis
** Data subjected to square root transformation

Weed control efficiency and Weed index

A perusal of data in Table 4 showed that weed control efficiency was significantly affected by different weed management practices. Weed free treatment recorded highest weed control efficiency at knee high, tasseling and harvesting stages (100%) followed by earthing up and weeding at 30 DAS and 45 DAS which recorded a value of 42.53, 35.79 and 36.68% at knee high, tasseling and harvesting stages, and showed significant variation with respect to the rest of treatments, whereas the lowest weed control efficiency was recorded by weedy check at knee high (0%), tasseling (0%) and harvesting stages (0%). Results presented in Table 4 showed that weed index was significantly affected by different weed management practices. Weedy check treatment recorded highest weed index (38.77) followed by atrazine @ 1.5 kg *a.i* ha^{-1} Early Post-emergence which recorded a value of 17.16, but showed significant variation when compared with the other treatments, whereas, the lowest weed index was recorded by weed free (0).This might be due to the continuous removal of weeds under weed free treatment that resulted in highest weed control efficiency and highest weed index under weedy check due to the presence of large no. of weeds. These findings are in close confirmation with those reported by Malviya and Singh [4], Nagalakshmi *et al.* [5], Sinha *et al*. [8].

Table 5:Effect of weed management practices on economics of baby corn (*Zea mays* L.)

Treatments	Total cost of cultivation (₹ ha^{-1})	Gross profit (₹ ha^{-1})			Net profit (₹ ha^{-1})	B:C ratio
		Baby corn	Green fodder	Total		
Farmers practice	55073	103560	32364	135924	80851	1.46
Earthing up and weeding	59573	116760	34573	151333	91760	1.54
Atrazine @ 1.5 kg a.i ha^{-1} PE	52223	99720	31960	131680	79457	1.52
Atrazine @1.5 kg a.i ha^{-1} Early PoE	52223	92160	31154	123314	71091	1.36
Paddy straw mulch	61923	108240	32983	141223	79300	1.28
Brown sarson mulch	61923	109140	33051	142191	80268	1.29
Black polyethylene mulch	82073	116040	33820	149860	67787	0.82
White polyethylene mulch	102073	114180	33695	147875	45802	0.44
Saw mulch	56173	104460	32807	137267	81094	1.44
Weedy check	50573	81600	29099	110699	60126	1.18
Weed free	68573	120540	35526	156066	87493	1.27

Economics

Economics in terms of net profit and benefit cost ratio with respect to baby corn and green fodder yield was worked out on pooled basis for various treatments. The highest net profit and benefit cost ratio of Rs. 91760 and 1.54 was recorded for earthing up and weeding at 30 and 45 DAS treatment and was followed by Atrazine @ 1.5 kg a.i ha^{-1} Pre-emergence which recorded a value of Rs. 79457 and 1.52 as net profit and benefit cost ratio respectively, whereas, white polyethylene recorded lowest values of net returns and benefit cost ratio of Rs. 45802 and 0.44 (Table 5) during the course of investigation [7].

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