The Pharma Innovation Journal 2022; 11(3): 919-923

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 919-923

www.thepharmajournal.com
Received: 06-12-2021
Accepted: 12-01-2022

HN Chaudhary
Department of Agronomy, NM College of Agriculture, NAU, Navsari, Gujarat, India

AP Patel
Department of Agronomy, College of Agriculture, Waghai, Gujarat, India

MP Joshi
Department of Agronomy, NM College of Agriculture, NAU, Navsari, Gujarat, India

RH Patel
Department of Agronomy, NM College of Agriculture, NAU, Navsari, Gujarat, India

Corresponding Author:
HN Chaudhary
Department of Agronomy, NM College of Agriculture, NAU, Navsari, Gujarat, India

Influence of integrated weed management practices on growth, yield attributes, yield, quality and nutrient uptake of *Rabi* popcorn (*Zea mays* L. Var. *Everta*)

HN Chaudhary, AP Patel, MP Joshi and RH Patel

Abstract
Field research was carried out during *rabi* 2017-18 at the College Farm, Navsari Agricultural University, Navsari on “Integrated weed management in *rabi* popcorn (*Zea mays* L. var. *Everta*) under South Gujarat condition”. The experimental soil was clayey in texture, low in available nitrogen (164 kg ha^{-1}), medium in available phosphorus (42 kg ha^{-1}) and high in available potash (315 kg ha^{-1}). Results revealed that in the case of different growth, yield attributes and yield, the treatment T_9 was performed better than all the other treatments but statistically remained at par with T_6, T_5 and T_4. However, plant population and per cent barren plant were not influenced significantly. Pop corn yield was significantly affected by different weed control methods therefor higher grain (3748 kg ha^{-1}) and stover yield (7898 kg ha^{-1}) were registered with T_9 but which is being statistically at par with T_6, T_5 and T_4. The N, P and K content (%) in grain, stover and weed were done not exert its significant influence, while higher N, P and K, kg ha^{-1} uptake was reported by grains and stover under the T_9, which was statistically at par with T_6, T_5 and T_4. While higher uptakes of nutrients were registered under T_{10} *fb* T_1, T_7 and T_3. Protein content (%) in grains failed to exert its significant effects. T_9 produced significantly maximum protein yield which was statistically at par with T_6 and T_5. After harvesting of the crop, available N, P and K kg ha^{-1} were recorded significantly maximum under T_9 *fb* T_6, T_5 and T_4. The maximum net realization (Rs 72143 ha^{-1}) was gained from T_6 *fb* T_5 and T_4. However, the maximum B: C ratio was recorded by treatment T_5 (2.96) followed by T_6 and T_9.

Keywords: Maize, popcorn, herbicide, topramezone, tembotrione, protein yield, nutrient uptake, grain yield etc.

Introduction
Maize (*Zea mays* L.) known as ‘Queen of Cereals’ is one of the important food crops of the world and ranks next only to wheat and rice as the third most important crop in the world as it is grown in more than 130 countries across the world. Maize being a C_4 plant is one of the most vibrant food grain crops having wider adaptability under diverse soil and climatic conditions due to this it is cultivated in all season’s *viz. Kharif, rabi* and spring. Today, it has become one of the leading food grain crops in many parts of the world, not only in tropical and subtropical areas but also in temperate and high hill ecologies (Kumar *et al*., 2015) [1]. Among the different types of maize, popcorn (*Zea mays* L. var. *everta*) is one of the major ones; its kernels are composed of hard starch when heated, swell and burst. Weeds are always associated with human endeavours and cause huge reductions in crop yields, increase the cost of cultivation, reduce input efficiency, interfere with agricultural operations, impair quality, act as alternate hosts for several insect pests, diseases and nematodes, several weed species compete with corn plant reduce yield. As there are limitations of every weed control method, therefore integrated weed management is a good option for sustainable agriculture as it involves the combination of all the possible methods to suppress the weeds below the economic threshold level, although some methods are effective against weeds, they prove uneconomical for the farmers or pose environmental hazards. Weeds compete with corn for light, nutrients, and water, especially during the first 3 to 5 weeks following the emergence of the crop**.** Yield loss due to weed in maize varies from 28 to 93%, depending on the type of weed flora and intensity and duration of the crop-weed competition. Pre-emergence application of herbicides may lead to cost-effective control of the weeds right from the sowing. Integrated Weed Management (IWM) is the combination of physical, mechanical, biological and chemical management practices to reduce a weed population to an acceptable level while preserving the quality of existing habitat, water, and other natural resources. The field of chemical weed control is practically remained limited up to certain crops because growers are not aware of proper doses of herbicides, time of application and their economics.

Practically no systematic research work has so far been done to evaluate the efficacy of new herbicides for weed management in *rabi* popcorn for this region.

Materials and Methods

An experiment was conducted at College Farm, NAU, Navsari during *rabi* season 2017-18 which is located 12 km away in the east from the Arabian seashore at 20^0 57' N latitude, 72^0 54' E longitude and 10 m above the mean sea level. The experimental field was "Deep Black" soils as old alluvium of basaltic material by its origin under the great group of *Ustochrepts*, a sub group of *Vertic Ustochrepts*, suborder *Ochrepts* and order *Inceptisols* with Jalalpore series. The experimental soil was clayey in texture, slightly alkaline (pH 8.23) with normal electric conductivity (0.30 ds m^{-1}), low in available nitrogen (164 kg ha^{-1}), medium in available phosphorus (42 kg ha^{-1}) and high in available potash (315 kg ha^{-1}). Ten treatments including in weed management practices *viz*., T_1: Atrazine 0.75 kg ha^{-1} as a pre-emergence, T_2: Atrazine 0.5 kg ha^{-1} as pre-emergence *fb* HW and IC at 40 DAS, T_3: Pendimethalin 0.9 kg ha^{-1} as pre-emergence *fb* HW and IC at 40 DAS, T_4: Atrazine 0.5 kg ha^{-1} + Pendimethalin 0.45 kg ha^{-1} tank-mix as pre-emergence *fb* HW and IC at 40 DAS, T_5: Atrazine 0.5 kg ha^{-1} *fb* tembotrione 0.12 kg ha^{-1} as post-emergence at 20 DAS, T_6: Atrazine 0.5 kg ha^{-1} *fb* topramezone 0.025 kg ha^{-1} as post-emergence at 20 DAS T_7: Atrazine 0.5 kg ha^{-1} as a pre-emergence *fb* 2,4-D (Na salt) 0.5 kg ha^{-1} as post-emergence at 40 DAS, T_8: HW and IC at 20 and 40 DAS T_9: Weed-free and T_{10}: Unweeded control were evaluated with an amber variety of popcorn as a test crop in randomized block design along with three replications. Popcorn cv. 'Amber' (110-120 days duration) seeds of 15 kg/ha were sown with hand in rows at 60 cm × 20 cm planting geometry. The crop was subjected to 120:60:00 kg N, P_2O_5 and K_2O ha^{-1}, P_2O_5 was supplied at basal and N was applied with three splits (50% basal, 25% at four-leaf stage, and 25% at the tasselling stage). The required amount of herbicides was sprayed using 400 l/ha of water with a knapsack sprayer fitted with a flat fan nozzle. At sampling time plant population counted from each net plot area in each experimental unit at 30 DAS and just before harvesting of the crop. Plant height (cm) and number of leaves per plant of five randomly selected plants for each experimental unit were measured at 30 DAS, 60 DAS and at harvest. Total number of barren plants were counted at the time of harvest in each net plot and later on converted into per cent barren plants. Yield and yield attributes of the crop were observed by various methods like number of cobs were counted from tagged five plants in each net plot at a time of picking and worked out the average per plant. The five cobs from the five tagged plants were used for studying this character. Length of the five cobs were measured in cm from the butt end to the tip of the cob and mean values were recorded. Cob thickness was measured with the help of vernier callipers and recorded to work out the average cob girth and expressed as cm Number of grains, grain weight (g) and 100-grains weight (g) per cob were counted from tagged five plant's cob in each net plot at a time of picking and worked out average. The grain and stover yield was recorded from the net plot area just after picking off the cob and expressed in kg ha^{-1}. Protein content of the grain (%) was find out by nitrogen content (%) multiply by 6.25, and in the case of protein yield (kg ha^{-1}), grain yield (kg ha^{-1}) was multiply by protein content (%) and its divided by 100. Estimation of available Nitrogen (N), Phosphorus (P), and Potassium (K) from soil will be carried out by alkaline $KMnO_4$ method (Subbiah and Asija, 1956) [21], olsen's method (Jackson, 1973) and flame photometric metod (Jackson, 1973) respectively. Comprehensive representative sample from grain, straw and weeds were taken separately for the estimation of nutrient content from each treatment from all the three replications. The samples were sun dried for a week and then oven dried at 65^0 C temperature for 24 hours and grinded into powder by mechanical grinder. Chemical studies pertaining to N, P and K content and their uptake by crop and weeds were determined as per methods like Modified kjeldahl's (Black 1979), Vanadomolybdo phosphoric acid yellow colour (Jackson 1973) and Falme photometric method (Jackson 1973) respectively. The nutrient uptake by grain, stover and weeds were calculated by using nutrient content (%) in grain/stover/weed were multiply by yield (kg ha^{-1}) of grain/stover/weed and it's divided by 100.

Results and Discussion

Crop growth parameters

Plant population and per cent barren plant were not influenced significantly but in the case of plant height at 30 DAS, 60 DAS and at harvest were recorded maximum with T_9 but remained at par with T_6, T_5, T_4, T_8, T_2, T_3, and T_7, T_6, T_5, T_4, T_8, T_2, T_3, T_7 and T_1 and T_7, T_6, T_5, T_4, T_8, T_2, T_3, T_7 and T_1 respectively. However lowest plant height at 30 DAS, 60 DAS and at harvest recorded with T_{10}. Number of leaves per plant at 30 DAS, 60 DAS and at harvest were recorded maximum with T_9 but remained at par with T_6 and T_5, T_4, T_8, T_2, T_3, and T_7, T_6, T_5, T_4, T_8, T_2, T_3, T_7 and T_1 and T_7, T_6, T_5, T_4, T_8, T_2, T_3, T_7 and T_1 respectively. However lowest number of leaves per plant at 30 DAS, 60 DAS and at harvest recorded with T_{10}. Table 1 shows that increasing in growth parameters in weed free were resulted in to less weed crop competition throughout the growth stage of crop and created favourable environment for plant growth. Thus, enhance availability of nutrients, water, light and space which might have accelerated the photosynthetic rate, thereby increasing the supply of carbohydrates, resulted in increase in growth characters. These findings are in agreement with those of Verma *et al*., (2009) [23] and Mathukia *et al*., (2014) [14].

Table 1: Effect of different weed control treatments on Plant height (cm), number of leaves per plant, barren plant (%) at, number of cob per plant, length of cob (cm)

	Treatments	Plant height (cm) at		Number of leaves per plant				Barren plant (%) at	No. of cob per plant	Length of cob (cm)
		30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest	Harvest		
T_1	Atrazine 0.75 kg ha^{-1} as at pre- emergence	37.11	120.81	155.18	5.26	10.05	11.89	5.38	1.46	18.23
T_2	Atrazine 0.5 kg ha^{-1} as pre-emergence *fb* HW and IC at 40 DAS	40.52	125.15	159.97	5.41	10.65	12.58	4.90	1.70	18.95
T_3	Pendimethalin 0.9 kg ha^{-1} as pre- emergence *fb* HW and IC at 40 DAS	38.90	123.66	158.33	5.39	10.39	12.19	5.20	1.58	18.47
T_4	Atrazine 0.5 kg ha^{-1}+ pendimethalin 0.45 kg ha^{-1} tank- mix as pre-emergence *fb* HW and IC at 40 DAS	43.09	130.93	166.37	5.59	11.18	13.05	4.76	1.81	20.39
T_5	Atrazine 0.5 kg ha^{-1} *fb* Tembotrione 0.12 kg ha $^{-1}$as post-emergence at 20 DAS	43.53	132.84	168.48	5.79	11.22	13.12	4.70	1.86	20.87
T_6	Atrazine 0.5 kg ha^{-1} *fb* Topramezone 0.025 kg ha^{-1}as post emergence at 20 DAS	44.22	134.38	170.19	5.90	11.41	13.69	4.57	1.89	21.35
T_7	Atrazine 0.5 kg ha^{-1} as a pre- emergence *fb* 2,4-D (Na salt) 0.5 kg ha^{-1} as post-emergence at 40 DAS	38.06	122.90	157.48	5.28	10.29	12.06	5.29	1.50	18.47
T_8	HW and IC at 20 and 40 DAS	41.85	127.14	162.18	5.54	10.92	12.80	4.83	1.75	19.43
T_9	Weed free	44.36	136.99	173.09	6.40	11.64	13.84	4.34	1.91	22.31
T_{10}	Unweeded control	35.23	99.51	131.60	4.98	9.05	10.14	5.55	1.38	17.51
	S.Em. ±	3.16	10.08	12.48	0.38	0.78	1.06	0.58	0.13	1.53
	C.D at 5%	6.64	21.18	26.23	0.80	1.65	2.23	NS	0.28	3.22
	C.V. %	7.77	8.04	7.79	6.91	7.38	8.48	11.77	8.14	7.83

Yield and yield attributes

Significantly the maximum number of cob per plant and length of cob (cm) were recorded with T_9 but remained at par with $T_{6,}$ T_5, T_4, T_8 and T_2 and $T_{6,}$ T_5, T_4 and T_8 and significantly lowest number of cob per plant and length of cob (cm) recorded under the T_{10}. However, significantly the maximum girth of cob was registered under the T_9 followed by T_6. While, significantly the lowest girth of cob was registered under the $T_{10.}$ Number of grains per cob, grain weight per cob (g) and 100 grain weight (g) were recorded maximum with T_9 but remained at par with $T_{6,}$ T_5 and T_4, and T_7 $T_{6,}$ T_5, T_4, T_8, T_2 and T_3 and $T_{6,}$ T_5, T_4, T_8 and T_2 respectively. However, lowest Number of grains per cob, grain weight per cob (g) and 100 grain weight (g) were recorded with T_{10} (Table 2). The superiority of these treatments could be practices might have produced more photosynthates and converted into numerous metabolites needed for such yield attributes. These findings are in close conformity with those reported by Kolage *et al*., (2004) [10], Mandal *et al*., (2004) [13], Nadiger *et al*., (2013) [15], Arvadia *et al*., (2013) [3] and Mathukia *et al*., (2014) [14]. The lowest values of yield attributes recorded under T_{10} may be due to severe competition by weed for resources, which made the crop plant incompetent to take up more moisture and nutrients, consequently growth was adversely affected. Poor growth and less uptake of nutrients with the unweeded control might have produced less photosynthates and partitioned less assimilates to numerous metabolic sinks and ultimately poor development of yield components. Higher grain (3747.63 kg ha^{-1}) and stover yield (7897.80 kg ha^{-1}) were registered with T_9 but which is being statistically at par with T_6, T_5 and T_4 and in the case of least grain (1567.37 kg ha^{-1}) and stover yield (3325.79 kg ha^{-1}) were recorded under the treatment $T_{10.}$ This might be due to effective control of weeds as well as higher weed control efficiency observed in respective treatments, besides minimum depletion of nutrients by weeds and better uptake by crop which cumulatively facilitated the crop to utilize more nutrients and water for better growth and development in terms of yield attributing character. Analogous findings have been reported Arvadiya *et al*., (2013) [3], Hatti *et al*., (2014) [8], Mathukia *et al*., (2014) [14], Sabiry *et al*., (2015) [18], Srinivasulu *et al*., (2016) [20].

Quality parameters

Protein content (%) in grains failed to exert its significant effects. T_9 produced significantly maximum protein yield (411.26 kg ha^{-1}) which was statistically at par with T_6 and T_5. While, T_{10} produced significantly the lowest protein yield (161.91 kg ha^{-1}) over the rest of the treatments (Table 2). This can be ascribed to better control of weeds by manual weeding and herbicidal methods as compared to the unweeded control condition, which might have increased absorption assimilation of nutrients leading to increased synthesis of quality parameters. The lowest quality parameters were observed under the unweeded control which can be ascribed to serve competition by weeds with the crop might have resulted in low absorption of nutrients and water by the crop, which adversely affected the assimilation of nutrients and ultimately with those reported by Ali (2016) [2] and Deevan *et al*., (2017) [6].

Table 2: Effect of different weed control treatments on girth of cob (cm), number of grains per cob, grain weight per cob, 100 grain weight (g), grain yield (kg ha^{-1}), stover yield (kg ha^{-1}), protein content (%) and protein yield (kg ha^{-1})

	Treatments	Girth of cob (cm)	No. of grains per cob	Grain weight per cob (g)	100 grain weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Protein content (%)	Protein yield (kg ha^{-1})
T_1	Atrazine 0.75 kg ha^{-1} as at pre- emergence	10.00	346.82	71.87	16.93	1885.20	3896.19	10.49	198.19
T_2	Atrazine 0.5 kg ha^{-1} as pre-emergence *fb* HW and IC at 40 DAS	10.69	390.38	78.65	17.97	2612.85	5646.59	10.65	280.32
T_3	Pendimethalin 0.9 kg ha^{-1} as pre- emergence *fb* HW and IC at 40 DAS	10.34	363.54	75.79	17.17	2539.40	5070.28	10.62	269.34
T_4	Atrazine 0.5 kg ha^{-1}+ pendimethalin 0.45 kg ha^{-1} tank- mix as pre-emergence *fb* HW and IC at 40 DAS	11.28	431.96	82.56	18.89	3019.26	6544.25	10.80	326.34
T_5	Atrazine 0.5 kg ha^{-1} *fb* Tembotrione 0.12 kg ha $^{-1}$as post-emergence at 20 DAS	11.45	459.90	84.26	19.55	3575.20	7205.07	10.84	387.53
T_6	Atrazine 0.5 kg ha^{-1} *fb* Topramezone 0.025 kg ha^{-1}as post emergence at 20 DAS	11.59	472.23	87.78	9.99	3688.74	7614.02	10.92	402.29
T_7	Atrazine 0.5 kg ha^{-1} as a pre- emergence *fb* 2,4-D (Na salt) 0.5 kg ha^{-1} as post-emergence at 40 DAS	10.18	369.04	73.83	17.44	2359.49	4378.64	10.52	246.98
T_8	HW and IC at 20 and 40 DAS	11.06	404.46	80.22	18.77	2733.55	6062.60	10.72	293.49
T_9	Weed free	11.93	483.44	88.82	20.87	3747.63	7897.80	10.96	411.26
T_{10}	Unweeded control	9.66	334.94	69.79	16.43	1567.37	3325.79	10.42	161.91
	S.Em. ±	0.92	25.67	6.25	1.46	361.58	751.64	0.51	39.87
	C.D at 5%	1.94	53.94	13.13	3.07	759.65	1579.14	NS	83.76
	C.V. (%)	8.56	6.33	7.87	7.94	13.04	13.04	4.82	13.39

Chemical studies

Significantly the maximum available N, P and K after harvest was recorded with T_9 but remained at par with T_6, T_5, T_4, T_8, T_2, T_3, and T_7 in case of available N, T_6, T_5, T_4, T_8 and T_2 in case of available P and T_6, T_5, T_4, T_8, T_2, T_3, T_7 and T_1 in case of available K. Significantly lowest available N, P and K (kg ha^{-1}) recorded under the T_{10}. Table 3 shows that N, P and K content in grain and stover (%) were not significantly influenced by different treatments of weed management. However, numerically higher nutrients content in grain and stover were found under the T_9. While lower nutrients content were noted under the T_{10}. While, significantly the maximum nutrients uptake by grain after harvest was recorded with T_9 but remained at par with treatment T_6 and T_5 in case of N uptake by grain, treatment T_6, T_5 and T_4 in case of P uptake by grain and treatment T_6, T_5 and T_4 in case of K uptake by grain. Significantly lowest uptake of N, P and K (kg ha^{-1}) by grain recorded under the treatment T_{10}. Significantly the maximum nutrients uptake by stover after harvest was recorded with T_9 but remained at par with treatment T_6, T_5 and T_4 in case of N uptake by stover, T_6 and T_5 in case of P uptake by stover and also T_6, T_5 and T_4 in case of K uptake by stover. Significantly the lowest uptake of by stover recorded under the T_{10}. N, P and K content in weed (%) were not significantly influenced by different treatments of weed management. While, significantly the maximum nutrients uptake by weed after harvest was recorded with T_{10} but remained at par with T_1, T_7 and T_3 in case of N, P and K uptake by weeds. Significantly minimum uptake of N, P and K (kg ha^{-1}) by weed recorded under the T_6. Table 4, shows that the nutrient uptake is a function of yield and nutrient concentration in plant. The higher uptake of nutrients might be due to better development of crop resulting lesser crop weed competition. Thus, improvement in uptake of N, P and k might be attributed to their concentration in grain and stover and associated with higher grain and stover yields. Similar results were reported by Kour *et al*., (2014) [11], Chetariya *et al*., (2015) [5] Samant *et al*., (2015) [19], Nazreen *et al*., (2017) [16] and Gaurav *et al*., (2018) [7].

Table 3: Nutrient content (%) in grain, stover and weed influenced by various weed control treatments

	Treatments	Nutrient content (%) in grain			Nutrient content (%) in Stover			Nutrient content (%) in weed		
		N	P	K	N	P	K	N	P	K
T_1	Atrazine 0.75 kg ha^{-1} as at pre- emergence	1.679	0.297	0.474	1.177	0.274	0.684	0.854	0.316	0.274
T_2	Atrazine 0.5 kg ha^{-1} as pre-emergence *fb* HW and IC at 40 DAS	1.703	0.313	0.493	1.215	0.289	0.699	0.850	0.316	0.275
T_3	Pendimethalin 0.9 kg ha^{-1} as pre- emergence *fb* HW and IC at 40 DAS	1.699	0.311	0.492	1.204	0.289	0.697	0.850	0.323	0.277
T_4	Atrazine 0.5 kg ha^{-1}+ pendimethalin 0.45 kg ha^{-1} tank- mix as pre-emergence *fb* HW and IC at 40 DAS	1.728	0.318	0.499	1.234	0.292	0.702	0.851	0.315	0.274
T_5	Atrazine 0.5 kg ha^{-1} *fb* Tembotrione 0.12 kg ha $^{-1}$as post-emergence at 20 DAS	1.734	0.321	0.502	1.251	0.300	0.710	0.850	0.314	0.277
T_6	Atrazine 0.5 kg ha^{-1} *fb* Topramezone 0.025 kg ha^{-1}as post emergence at 20 DAS	1.747	0.324	0.505	1.258	0.304	0.714	0.850	0.318	0.278
T_7	Atrazine 0.5 kg ha^{-1} as a pre- emergence *fb* 2,4-D (Na salt) 0.5 kg ha^{-1} as post-emergence at 40 DAS	1.683	0.306	0.487	1.194	0.284	0.694	0.851	0.316	0.277
T_8	HW and IC at 20 and 40 DAS	1.716	0.315	0.496	1.222	0.291	0.701	0.850	0.314	0.273
T_9	Weed free	1.755	0.329	0.520	1.266	0.305	0.715	-	-	-
T_{10}	Unweeded control	1.667	0.293	0.463	1.161	0.263	0.673	0.850	0.315	0.278
	S.Em. ±	0.082	0.020	0.023	0.054	0.014	0.029	0.024	0.009	0.007
	C.D at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
	C.V. %	4.812	6.520	4.786	4.502	5.095	4.163	4.84	5.11	4.33

Economics (Rs ha^{-1})

Results revealed that the maximum net realization of (Rs 72143 ha^{-1}) was gained from T_6 followed by T_9 and T_5 with (Rs 69603 ha^{-1}) However, the maximum B: C ratio (2.96) was recorded by T_5 followed by T_6 (2.95) and T_9 (2.43). (Table 4).

This might be due to effective and efficient control of weeds by integration of hand weeding and pre-emergence and post emergence application of herbicides. The higher benefits obtained under these treatments were also due to comparatively higher seed and stover yield of popcorn. Similar results were also reported by Malviya and Singh (2007) [12], Rao *et al*., (2009) [17], Arvadia *et al*., (2013) [3], Mathukia *et al*., (2014) [14], Akhtar *et al*., (2015) [1] and Swetha *et al*., (2015) [22].

Table 4: Nutrient uptake by grain, Stover and weed, and also economic as influenced by various weed control treatments

	Treatments	Nutrient uptake (kg ha^{-1}) by grain			Nutrient uptake(kg ha^{-1}) by Stover			Nutrient uptake (kg ha^{-1}) by weed			Net return (Rs ha^{-1})	B:C ratio
		N	P	K	N	P	K	N	P	K		
T_1	Atrazine 0.75 kg ha^{-1} as at pre- emergence	31.71	5.56	8.91	45.97	10.71	26.69	1.82	0.67	0.58	26172	1.13
T_2	Atrazine 0.5 kg ha^{-1} as pre-emergence *fb* HW and IC at 40 DAS	44.85	8.12	12.84	69.11	16.38	39.51	1.57	0.58	0.51	44410	1.79
T_3	Pendimethalin 0.9 kg ha^{-1} as pre- emergence *fb* HW and IC at 40 DAS	43.09	7.99	12.60	61.00	14.56	35.08	1.66	0.63	0.54	40773	1.62
T_4	Atrazine 0.5 kg ha^{-1}+ pendimethalin 0.45 kg ha^{-1} tank- mix as pre-emergence *fb* HW and IC at 40 DAS	52.21	9.61	15.08	80.79	19.16	45.94	1.42	0.53	0.46	54931	2.19
T_5	Atrazine 0.5 kg ha^{-1} *fb* Tembotrione 0.12 kg ha $^{-1}$as post-emergence at 20 DAS	62.00	11.50	17.98	90.18	21.62	51.08	1.34	0.50	0.44	69603	2.96
T_6	Atrazine 0.5 kg ha^{-1} *fb* Topramezone 0.025 kg ha^{-1}as post emergence at 20 DAS	64.36	11.96	18.65	95.68	23.22	54.37	1.26	0.48	0.41	72143	2.95
T_7	Atrazine 0.5 kg ha^{-1} as a pre- emergence *fb* 2,4-D (Na salt) 0.5 kg ha^{-1} as post-emergence at 40 DAS	39.51	7.15	11.42	52.00	12.51	30.51	1.73	0.65	0.57	37024	1.59
T_8	HW and IC at 20 and 40 DAS	46.95	8.65	13.61	74.15	17.65	42.45	1.49	0.55	0.48	46587	1.77
T_9	Weed free	65.80	12.40	19.20	100.03	24.08	56.34	-	-	-	69882	2.43
T_{10}	Unweeded control	25.90	4.65	7.32	38.33	8.71	22.25	1.98	0.73	0.65	18345	0.80
	S.Em. ±	6.37	1.36	2.04	9.64	2.16	5.13	0.140	0.052	0.044	-	-
	C.D at 5%	13.40	2.87	4.28	20.26	4.55	10.78	0.42	0.16	0.13	-	-
	C.V. %	13.39	15.60	14.83	13.63	12.85	12.69	15.24	15.24	14.95	-	-

Conclusion

After the results of experiment we can conclude that labours are not easily available, another alternative is the pre-emergence application of Atrazine 0.5 kg ha^{-1} *fb* topramezone 0.025 kg ha^{-1} as post-emergence at 20 DAS or tembotrione 0.12 kg ha^{-1} (as post-emergence) also equally effective (for potential and profitable maize production) for weed control in *rabi* popcorn.

References

1. Akhtar P, Kumar A, Kumar J, Sharma AK, Bharti V. Efficacy of tembotrione on mixed weed flora and yield of spring maize (*Zea mays* L.) under irrigated sub-tropical shiwalik foothills. 25th Asian Pacific Weed Science Society Conference on Weed Science for Sustainable Agriculture, Environment and Biodiversity. 2015 Oct, 13-16.
2. Ali QJ. Integrated weed management study in summer maize (*Zea mays* L.) under south Gujarat condition. M.Sc. (Agri.) thesis, Navsari Agricultural University, Navsari. 2016.
3. Arvadiya LK, Raj VC, Patel TU, Arvadia MK, Thanki JD. Productivity and economics of sweetcorn (*Zea mays* L.) as influenced by planting geometry and weed management. Research on Crops. 2013;14(3):748-752.
4. Black CA. Method of soil analysis, American society of Agronomy, Wisconsin, U. S. A. 1965.
5. Chetariya MD. Integrated weed management in *rabi* sweet corn, (*Zea mays* L. var. *Saccharata*) under south Gujarat condition. M.Sc. (Agri.) thesis, Navsari Agricultural University, Navsari. 2015.
6. Deewan P, Mundra SL, Singh D, Meena M, Verma R, Sharma NK. Effect of Weed and Nutrient management on Growth, Productivity and Protein content of Quality Protein Maize (*Zea mays* L.). Journal of Pharmacognosy and Phytochemistry. 2017;6(1):271-274.
7. Gaurav SK, Meena RS, Maurya AC, Kumar S. Nutrients Uptake and Available Nutrients Status in Soil as Influenced by Sowing Methods and Herbicides in Kharif Maize (*Zea mays* L.) International Journal of Agriculture, Environment and Biotechnology 2018;11(1):17-24.
8. Hatti V, Sanjay MT, Prasad TR, Murthy KK, Kumbar B, Shruthi MK. Effect of new herbicide molecules on yield, soil microbial biomass and their phytotoxicity on maize (*Zea mays* L.) under irrigated conditions. The Bioscan, 2014;9(3):1127-1130.
9. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd, New Delhi. 1974.
10. Kolage AK, Shinde SH, Bhilare RL. Weed management in kharif maize. Journal of Maharashtra Agricultural Universities. 2004;29(1):110-111.
11. Kour P, Kumar A, Sharma BC, Kour R, Kumar J, Sharma N. Effects of weed management on crop productivity of winter maize (*Zea mays* L.) + potato (Solanum tuberosum) intercropping system in Shiwalik foothills of Jammu and Kashmir. Indian Journal of Agronomy, Solanum tuberosum. 2014;59(1):65-69.
12. Malviya A, Singh B. Weed dynamics, productivity and economics of maize (*Zea mays* L.) as affected by integrated weed management under rainfed condition. Indian Journal of Agronomy. 2007;52(4):321-324.
13. Mandal S, Mondal S, Nath S. Effect of integrated weed management on yield components, yield and economics of babycorn (*Zea mays* L.). Annals of Agricultural Research. 2004;25(2):242-244.
14. Mathukia RK, Dobariya VK, Gohil BS, Chhodavadia SK. Integrated weed management in *rabi* sweet corn (*Zea mays* L. var. *Saccharata*). Advances in Crop Science and Technology. 2014;2:1-4.
15. Nadiger S, Babu R, Arvind Kumar BN. Bio-efficacy of pre emergence herbicides on weed management in maize. Karnataka Journal of Agricultural Sciences. 2013;26(1):17-19.
16. Nazreen S, Subramanyam D, Sunitha N, Umamahesh V. Nutrient uptake of maize and its associated weeds as influenced by sequential application of herbicides. Int. J Pure App. Biosci. 2017;5(6):496-500.
17. Rao AS, Ratnam M, Reddy TY. Weed management in zero-till sown maize. Indian Journal of Weed Science. 2009;41(1-2):46-49.
18. Sabiry B, Babu R, Saunshi S, Guled S, Rajput RB. Effect of early post emergence herbicides on soil dehydrogenase activity and grain yield of maize. 25th Asian- Pacific Weed Science Society Conference on Weed Science for Sustainable Agriculture, Environment and Biodiversity, Hyderabad, India during. 2015 Oct, 13-16.
19. Samant TK, Dhir BC, Mohanty B. Weed growth, yield components, productivity, economics and nutrient uptake of maize (*Zea mays* L.) as influenced by various herbicide applications under rainfed condition. Scholars J Agri. Vet. 2015;2(1B):79-83.
20. Srinivasulu K, Rao SBSN, Rani BP, Rao KK, Reddy KB, Babu DV. Weed management in zero till maize (*Zea mays* L.) grown under rice fallows. International Journal of Tropical Agriculture. 2016;34(1):211-214.
21. Subbiah BV, Asija GC. A rapid procedure for the estimation of available nitrogen in soils. Current Science. 1956;25:259-260.
22. Swetha K, Madhavi M, Pratibha G, Ramprakash T. Weed management with new generation herbicides in maize. Indian Journal of Weed Science. 2015;47(4):432-433.
23. Verma VK, Tewari AN, Dhemri S. Effect of atrazine on weed management in winter maize-green gram cropping system in central plain zone of Uttar Pradesh. Indian Journal of Weed Science. 2009;41(1-2):41-45.