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AGRONOMY

Influence of Weed Management Practices on Weed Control Efficiency, Yield and Economics in Sweet Corn *(Zea mays* L. saccharata)

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ABSTRACT

The field experiment was conducted in sandy loam soil at Research Farm, M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Bagusala village, Paralakhemundi, Odisha, India during summer season of 2018. The experiment was laid out in randomized complete block design with three replications and eight treatments. The herbicidal treatmentrs of pre emergence (PE) application of either pendimethalin @ 0.75kg/ha, oxyfluorfen @ 50 g/ha and metribuzin @ 0.3 kg/ha at 1 day after sowing (DAS) or the same herbicides supplimented with straw mulching (SM) @ 6 t/ha at 30 DAS were compared with intercultivation twice at 20 and 40 DAS and unweeded control.

Experimental results revealed that weed mangement treatments significantly influenced the yield attributes and yield of sweet corn along with improvement in weed control efficiency. Pre emergence application of either metribuzin @ 0.30 kg/ha or pendimethalin @ 0.75 kg /ha at 1 DAS in combination with SM @ 6.0 t/ha at 30 DAS remarkbly enhanced the yield attributes such as number of cobs/plant, cob length, cob girth and cob weight. The green cob (11.78 t /ha) and forage (14.55 t/ha) yield were the highest with metribuzin @ 0.30 kg/ha as PE at 1 DAS + SM @ 6 t/ha at 30 DAS. It was followed by pendimethalin @ 0.75 kg /ha as PE at 1 DAS + SM @ 6 t/ha at 30 DAS producing the green cob and forage yield of 11.21 and 14.22 t/ha, respectively. The reduction in yield was to the tune of 35.10% due to uninterrupted growth of weeds. The maximum gross return (₹ 250150 /ha), net return (₹ 181635 /ha) and B:C ratio (2.65) were obtained with PE application of metribuzin @ 0.30 k g/ha at 1 DAS + SM @ 6 t/ha at 30 DAS. It was followed by pendimethalin @ 0.75 kg /ha as PE at 1 DAS + SM @ 6 t/ha at 30 DAS registering the gross and net return of ₹ 238420/ ha and ₹ 169605 /ha, respectively.

Highlights

- Pre emergence application of metribuzin @ 0.3 kg/ha at 1 day after sowing supplimented with straw mulching @ 6 t/ha at 30 days after sowing was observed as an efficient and economical method of weed management in sweet corn.

Keywords: Weed management, pre emergence application, pendimethalin, oxyfluorfen, metribuzin, straw mulching, weed control efficiency, yield, economics and sweet corn

Sweet corn is successfully grown for vegetable purpose in countries like Canada, United States of America and Sri Lanka. In India, it's cultivation is popular in Haryana, Maharashtra, Meghalaya, Karnataka, and Andhra Pradesh. Now a days, the cultivation of sweet corn is extended to other states to meet the local need of urban population. Among the several constraints in sweet corn cultivation, the most critical for low yield is the weed competetion for nutrients, water, sunlight and space. In the summer maize, weed emerges most often after the first irrigation. However, wider row spacing, slow initial growth and liberal use of irrigation and fertilizers lead to more growth of weeds. The heavy weed infestation resulted in huge losses ranging from 60 to 83 % in maize grown

in a wider spacing (Kumar *et al.* 2015 and Ehsas *et al.* 2016). The choice of weed control methods largely depends on it's effectiveness and economics. Manual weeding is very tedious, time taking and costly. The chemical method of weed control as pre-emergence application of herbicides is the cost effective control of the weeds during initial period of crop development stage. The pre-emergence use of pendimethalin (Verma *et al.* 2015; Dobariya *et al*. 2015; and Barad *et al.* 2016), metribuzin (Shaba *et al.* 2015 and Roshdy 2017) and oxyfluorfen (Nadiger *et al.* 2013 and Madhavi *et al*. 2013) has been tested as a method of weed control in maize by many weed scientists.

But the efficacy of herbicides is reduced by various climatic and edaphic factors. Therefore, the only alternative is required to explore the integration of pre emergence application of herbicides with cultural method to give priority for weed management in Indian agriculture scenario. The farmers are used to burn the crop residues after harvest of rice mechanically by combine harvester. It pollutes the atmosphere and causes human health hazards. Under such situation, straw mulching is the effective method to manage the weeds successfully and also prevents atmospheric pollution and increases the soil fertility due to in situ decomposition of paddy straw. Several workers reported the favourable effect of mulching in reducing the weed completion to serve as an effective way of weed management (Olabode and Sangodele 2015 and Ehsas *et al.* 2016). Keeping the above facts in view, the present investigation entitled "Integrated weed management in sweet corn (*Zea mays* L. saccharata)'' was carried out to devise an acceptable, effective and economical method of weed management.

MATERIALS AND METHODS

A field experiment was carried out in sandy loam soil at Research Farm, Bagusala, M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi Odisha during summer 2018. The of experimental soil was slighly acidic (pH of 6.8) with low in available N (158.83 kg /ha) and P_2O_5 (10.82 kg /ha) and medium in available K_2O (147.67 kg/ha). The randomized complete block design was adopted with three replications and eight treatments in plot size of 4. 8 m × 4. 20 m. The details of weed management treatments were pre emergence application of pendimethalin @ 0.75kg/ha at 1 DAS**,** pre emergence application of oxyfluorfen @ 50 g/ha at 1 DAS, pre emergence application of metribuzin @ 0.3 kg/ha at 1 DAS, pre emergence application of pendimethalin @ 0.75 kg/ha at 1 DAS + strawmulching (SM) @ 6 t/ha at 30 DAS, pre emergence application of oxyfluorfen @ 50 g/ha at 1 DAS + SM @ 6 t/ha at 30 DAS, pre emergence application of metribuzin @ 0.3 kg/ha + SM @ 6 t/ha at 30DAS, intercultivation twice at 20 and 40 DAS and unweeded control (Weedy check). The sweet corn hybrid sugar-75 was sown in line at the depyh of 5 cm on 28 th January, 2018 with spacing of 60 cm from row to row and 25 cm from seed to seed. The recommended dose of 120 – 60 – 60 kg of N, P_2O_5 and K_2O was used in sweet corn crop. At sowing, full dose of P_2O_5, half of K_2O and half nitrogen were applied as basal. Rest amount of N and K_2O were topdressed at knee high stage at 30 days after sowing (DAS). The pre emergence spray of herbicides as per the ttreatments specification was done with knapsack hand operated sprayer using spray volume of 500 l /ha at one day after sowing. The weed dry weight was taken from all treatments from as area of 50 cm × 50 cm quadrant at 45 and 60 DAS. The plant protection measure was followed according to recommeded practices of th region. The green cob was harvested two times by pluking at soft dough stage on 13th and 20th April, 2018. The crop was harvested as green fodder purpose after final plucking. The biometric observation on yield attributes and yield were recorded at plucking of cob along with green forage yield after harvesting the whole plant from each plot.

RESULTS AND DISCUSSION

Major weed floras in experimental site

The experimental field was infested with the major weed species like *Dactyloctenium aegyptium* L. *Digitaria sanguinalis* L. and *Sporobolus diander* L., *Echinochloa colunum* L. and *Cynodon dactylon* L., amongst grasses, *Cyperus rotundus* L. as a sedge and *Phyllanthus niruri* L., *Oldenlandia corymbosa* L. *Cleome gynandra* L., *Physalis minima* L., *Euphorbia hirta* L., *Heliotropium indicum* L. and *Chenopodium album* L. under broad leaved weeds.

Weed control efficiency

The weed control efficiency (WCE) recoded at at 45 days after sowing (DAS) was improved with pre emergence application of all herbicides supplimented with straw mulching at 45 days after sowing (Table 1). Application of pendimethalin @ 0.75kg/ha, metribuzin @ 0.3 kg/ha and oxyfluorfen @ 50 g/ha applied as PE at 1 DAS + straw mulching @ 6 t/ha recorded more or less equal values of WCE ranging from 98 .57 to 98.27%. It was followed by inter cultivation at 20 and 40 DAS (95.14%). The weed control efficiency obtained with all pre emergence application of herbicides at 1 DAS and weed check was lower than the above mentioned treatments during 45 DAS. Improvement in WCE was achieved due to efficient method of weed management resulted in reduced biomass production of weeds at initial crop growth stage with pre emergence application of herbicides and effective weed control by mulching at later stage provided weed free condition. Similar favourable effect in pre emergence application of metribuzin (Shaba *et al*. 2015) and pre emergence application of Pendimethalin or oxyfluorfen + intercultivation (Madhavi *et al*. 2013) and mulching (Olabode and Sangodele 2015; Abdullah *et al.* 2016 and Ehsas *et al.* 2016) in reducing the weed dry matter accumulation and increasing the weed control efficiency was noticed earlier by different research workers.

Yield attributes of sweet corn

The data on yield parameters with respect to cobs/ plant, cob length, cob girth and cob weight are presented in (Table 1). It indicated that the weed management treatments exerted significant effect on yield components of sweet corn. The maximum number of cobs/plant was recorded in pendimethalin @ 0.75 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ ha (1.27) closely followed by metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (1.23) and pendimethalin @ 0.75 kg/ha as PE at 1 DAS which were at par. The least number of cobs /plant was recorded in unweeded check (1.0). Length of cob was maximum with metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (22.14 cm) closely followed by pendimethalin @ 0.75 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (22.13 cm). The cob length did not vary significantly among all other weed management treatments except in unweeded control. Metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha gave the highest cob girth (19.07 cm) followed by pendimethalin @ 0.75 kg/ ha as PE at 1 DAS + straw mulching @ 6 t/ha (18.25 cm) which remained at par with other treatments except pre emergence application of pendimethalin @ 0.75kg/ha as PE at 1 DAS and oxyfluorfen @ 50 g/ha as PE at 1 DAS and unweeded control. The highest cob weight was obtained with metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @

Table 1: Weed control efficiency (WCE) and yield components of sweet corn as influenced by weed management treatments

Treatments	WCE at 45 DAS (%)	Cobs/ plant	Cob length (cm)	Cob girth (cm)	Cob weight (g)
Pendimethalin @ 0.75 kg/ha as PE at1DAS	57.80	1.20	21.8	17.60	296
Oxyfluorfen @ 50 g/ha as PE at 1 DAS	53.25	1.07	20.57	17.53	289
Metribuzin @ 0.3 kg/ha as PE at 1 DAS	60.69	1.13	21.40	17.77	299
Pendimethalin @ 0.75 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha	98.57	1.27	22.13	18.25	305
Oxyfluorfen @ 50 g/ha as PE at 1 DAS + straw mulching @ 6 t/ha	98.27	1.20	21.80	18.13	301
Metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha	98.45	1.23	22.14	19.07	308
Inter cultivation at 20 and 40 DAS	95.14	1.13	20.67	18.13	292
Un weeded control	—	1.00	18.00	16.55	246
S. Em. (±)	—	0.04	0.71	0.43	9
CD (P=0.05)	—	0.12	2.16	1.30	28

6 t/ha (308 g) closely followed by pendimethalin @ 0.75 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (305 g). The cob weight recorded in all the weed management treatments except weedy check did not differ significantly among themselves with regard to cob weight. The least competition offered by weeds provided favourable condition for better availability and utilization of nutrients and moisture at crucial growth stages under those treatments resulted in enhanced the crop growth and greater leaf area for efficient photosynthetic activity as well as maximum translocation of photosynthates from source to sink ultimately resulted in enhancement of all yield attributes. Similar favourable effect of pre emergence application of herbicides like pendimethalin (Dobariya *et al.* 2015 and Barad *et al.* 2016), metribuzin (Roshdy *et al.* 2017) and oxyfluorfen (Nadiger *et al.* 2013) and in increasing the yield attributes on maize is corroborated with the findings of earlier weed scientists. Straw mulching successfully restricted weed emergence by curtailing solar radiation thus provided favourable growth factor for enhancing yield attributes. It is in pipe line with the works of Abdullah *et al.* (2016).

Green cob and forage yield and weed index

The data on green cob and forage yield and weed index (%) depicted in Table 2 indicated that green cob and forage yield were significantly affected by weed management treatments. The highest green cob yield was recorded with metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (11.78 t/ha) closely followed by pendimethalin @ 0.75 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (11.21 t/ha). This performance was on par with remaining weed management treatments except unweeded control. Application of metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha recorded maximum green forage yield (14.55 t/ha) being at par with pendimethalin @ 1 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (14.22 t/ha). Those treatments also remained at par with all the weed management treatments except oxyfluorfen @ 50.g /ha as PE at 1DAS and unweeded control. The increased yield in those treatments could be attributed due to improved yield components such as higher of cob plant^{-1}, cob length, cob girth and cob weight. Thus, resultant effect on improvement in total dry matter accumulation in sweet corn as

Table 2: Effect of weed management treatments on green cob yield, green forage yield, weed index and economics of sweet corn

Treatments	Green cob yield (t/ha)	Green forage yield (t/ha)	Weed index (%)	Cost of cultivation (₹/ha	Net profit (₹/ha)	Benefit : cost ratio
Pendimethalin @ 0.75 kg/ha as PE at 1 DAS	10.4	12.98	11.77	65815	155165	2.36
Oxyfluorfen @ 50 g/ha as PE at 1 DAS	10.15	12.29	13.86	64696	150594	2.33
Metribuzin @ 0.3 kg/ha as PE at 1 DAS	10.85	12.70	7.92	65515	164185	2.51
Pendimethalin @ 0.75 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha	11.21	14.22	4.91	68815	169605	2.46
Oxyfluorfen @50 g/ha as PE at 1 DAS + straw mulching @ 6 t/ha	11.11	13.42	5.71	67696	167924	2.48
Metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha	11.78	14.55	—	68515	181635	2.65
Inter cultivation at 20 and 40 DAS	10.99	13.24	6.70	83190	149850	1.80
Un weeded control	7.65	9.07	35.10	63190	98880	1.56
S. Em. (±)	0.54	0.72	—	—	—	—
CD (P=0.05)	1.63	2.19	—	—	—	—
CV (%)	8.84	9.75	—	—	—	—

Seeling price of produce – Green cob = ₹ 20000 /t and green forage = ₹ 1000 / t

a result of lower weed competition was favourable in proper utilization of growth factors there by reflected green cob and forage yield. This result is in accordance with the various research workers while working with pre mergence application of pendimethalin (Madhavi *et al*. 2013; Verma *et al.* 2015 and Barad *et al.* 2016), metribuzin (Roshdy *et al*. 2017) and oxyfluorfen (Nadiger *et al.* 2013 and Hatti *et al.* 2014) and with straw mulching (Abdullah *et al*. 2016).

The efficient weed index was observed in pendimethalin @ 0.75 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (4.91 %) closely followed by oxyfluorfen @50 g/ha as PE at 1 DAS + straw mulching @ 6 t/ha (5.71%) where in metribuzin @ 0.3 kg ha^{-1} as pre emergence 1 DAS with straw mulching @ 6 t ha^{-1} was taken as best treatments (Table 2). The uninterrupted growth of weeds reduced the green cob yield by 35.10 % compared with the best treatment. Dobariya *et al*. (2015) reported the reduction in yield by 29.86% due to uninterrupted growth of weeds in sweet corn.

Economics of cultivation

The economics of cultivation calculated basing upon prevailing market price revealed that the cost of cultivation was maximum in inter cultivation at 20 and 40 DAS (₹ 83190 /ha) and the lowest (₹ 63190/ ha) in unweeded check plot (Table 2). Application of metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha registered the highest net return (₹ 181635/ ha) followed by pendimethalin @ 0.75 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (₹ 169605/ ha). The cost benefit ratio was maximum in metribuzin @ 0.3 kg/ha as PE at 1 DAS + straw mulching @ 6 t/ha (2.65) and the same metribuzin as pre emergence spray recorded the next value of 2.51. This is because of higher economic yield, net return and lower cost of cultivation. The increase in benefit under these treatments might be due to enhancement in green cob and forage production leading to increased monetary return with comparatively acceptable cost of cultivation. These findings are in close vicinity with the views of Hawaldar and Agasimani (2012) and Arvadiya *et al.* (2012).

CONCLUSION

The pre emergence application of metribuzin @ 0.3 kg/ha at 1 DAS + straw mulching @ 6 t/ha enhanced the yield attributes like cobs/plant, cob length, cob girth and green cob weight and gree green cob (11.78 t/ha) and forage (11.21 t/ha) yield of sweet corn along with net return return (₹ 181635/ ha) and benefit cost ratio (2.65).

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