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Impact of Integrated Nutrient and Weed Management on Yield Parameters and Yield of Zero Till Maize

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ABSTRACT: A field investigation was carried out during *rabi,* 2016-17 and 2017-18 at College Farm, Agricultural College, Aswaraopet, Bhadradri Kothagudem Dist. in sandy clay loam soil to evaluate and suggest suitable nutrient and weed management practice for zero tillage maize. During *rabi*, maize was grown under zero tillage in sequence to semi dry rice and followed three nutrient treatments {100% RDF, 75% RDF + 25% N through vermicompost and 75% RDF + 25% N through FYM} and four weed management practices {Control, Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24 SL 0.6 kg a.i ha^{-1} *fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS, Atrazine 50 WP 500 g a.i ha^{-1} *fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS and Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice} were imposed in maize as sub plot treatments in split plot design which were replicated thrice. Significantly, enhanced yield components *viz.*, no. of grains row^{-1}, no. of grain rows cob^{-1}, total no. of grains cob^{-1}, cob weight, cob yield and grain and stover yield of maize were noticed with 75% RDF + 25% N through vermicompost and was at par with 75% RDF + 25% N through FYM in contrast to 100% RDF. Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice registered significantly higher yield parameters and yield while lower values were observed with control in zero till maize. Interaction effect of nutrient and weed management practices on yield parameters, grain and stover yield of zero till maize was found to be non-significant.

Keywords: Nutrient, weed, yield attributes, grain yield, stover yield, zero till maize.

INTRODUCTION

Maize, a crop of worldwide economic importance together with rice and wheat provides approximately 30% of the food calories to more than 4.5 billion people in 94 developing countries and demand for maize in these countries is expected to double by 2050. In India, maize is considered as third most important crop among the cereals and contributes to nearly 9% of the national food basket (Gul *et al.,* 2021). Worldwide, maize is grown in an area of 197.20 M ha with production of 1148.49 Mt and productivity of 5824 kg ha^{-1} (FAOSTAT, 2019-20) while, in India area is about 9.56 M ha with a production of 28.77 M t and 3006 kg ha^{-1} productivity. In Telangana, maize occupies an area of 0.56 M ha with production and productivity of 2.99 M t and 5347 kg ha^{-1}, respectively (CMIE, 2019-20). Maize yields in India need to be increased significantly so as to meet food, feed and industrial needs. Therefore, it is emerging as an alternative option for replacing rice in rice-based cropping systems in water scarcity areas enhancing resource use efficiency (Gupta *et al.,* 2002; Komarek *et al.,* 2021) and also as a viable option for farmers as a component crop of rice-based systems, due to higher productivity and profitability of maize compared to winter rice or wheat in South Asia (Ali *et al.,* 2008; Ali *et al.,* 2009; Voison *et al.,* 2018).

Generally, rice is harvested during second fortnight of November. Thereby farmers can sow maize in time under zero tillage (Jug *et al*., 2019). Integrated nutrient management studies for maize hybrids are extremely productive (Wang *et al*., 2020), but limited in South Asia. Rice-maize sequence in traditional areas aids in overcoming planting difficulties in rice fallows, reduces weeds and improves fertilizers and water use efficiency with a potential benefit in saving the cost of production (Rao and Ramana 2017). Wider spacing, erect and initially slow growth of crop encountered weed problems under zero till maize after rice harvest (Triveni *et al*., 2017; Alarcona *et al*., 2018). Keeping this in view, the present investigation is chosen to enhance the sustainability and productivity of crop and soil with the adoption of different nutrient and weed management practices in zero tillage maize.

Material and Methods: Zero till maize variety DHM 117 was sown during 2016-17 and 2017-18 in *rabi* season at College Farm, Agricultural College, Aswaraopet, Bhadradri Kothagudem District, Professor Jayashankar Telangana State Agricultural University situated at an altitude of 162 m above mean sea level at 17°24′54″ N latitude and 81°10′34″ E longitude which is located in the Central Telangana Agro climatic Zone. The experiment was laid out in split plot design with twelve treatments and three replications in sandy clay loam texture. Initial growth of maize crop was found slow due to prevailing of slightly low temperatures. But it did not show any adverse effect on crop growth and productivity. Two maize seeds per hill were dibbled at a row spacing of 60 cm and plant-plant spacing of 20 cm. At two weeks after sowing, excess seedlings were thinned and retaining only one healthy seedling per hill in order to maintain optimum population. The recommended fertilizer doses as Urea, SSP and Muriate of Potash @ 180: 80: 80 kg N, P_2O_5, and K_2O kg ha^{-1}, respectively were applied as per treatments in the form of inorganic fertilizers and organic manures. Split doses of nitrogen were top dressed, 1/3rd each at sowing, knee high stage, and at tasseling stage. The same process was followed in both *rabi*, 2016-17 and 2017-18 of zero till maize. Three levels of nutrient management (M_1 - 100% RDF, M_2 - 75% RDF + 25% N through vermicompost and M_3 - 75% RDF + 25% N through FYM were imposed to main plots and four levels of weed management practices to sub plots *viz.,* S_1 - Control, S_2 - Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24 SL 0.6 kg a.i ha^{-1} *fb* 2,4–D 0.5 kg a.i ha^{-1} at 25 DAS, S_3 - Atrazine 50 WP 500 g a.i ha^{-1} *fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50WP 500 g a.i ha^{-1}) at 25 DAS and S_4 - Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice. No. of cobs $plant^{-1}$ from the five randomly selected plants from each plot was counted and their average was computed. From five randomly chosen cobs, mean value of the length of cob was determined from blunt end to the tip of shank and expressed in centimeters. The girth of five randomly selected cobs was measured in middle of cob portion, possessing maximum girth and average girth was expressed in centimeters. The number of grain rows per cob were counted for five randomly chosen cobs and expressed as per cob basis. The total number of grains per row of five randomly selected cobs were counted and expressed as per cob basis. Number of grains row^{-1} and number of grain rows cob^{-1} were counted from the five randomly selected cobs. Later, total number of grains cob^{-1} were calculated by multiplying the number of grains row^{-1} and number of grain rows cob^{-1} and average was expressed as total number of grains cob^{-1}. Weight of hundred grains was recorded from composite sample of net plot area produce in each treatment and their test weight was recorded and expressed in grams. Cob yield is weight of cobs without husk was measured after harvest from the net plot area and converted to kg ha^{-1}. Cobs from five randomly selected plants were sun-dried and weighed. The average value was calculated to get the dry weight cob^{-1} and expressed as cob weight in g. Sun dried seeds with 14% moisture content obtained from the net plot area was measured and expressed as grain yield in kg ha^{-1}. Stover from net plot area was weighed after properly sun dried and indicated as stover yield in kg ha^{-1}.

The data collected from the experiment were analyzed statistically by analysis of variance method for split plot design (Gomez and Gomez 1984). Whenever the treatment differences were found significant (F test), critical differences were worked out at five per cent probability level. Treatment differences that were non-significant were denoted by NS. If the difference between two treatments was more than critical difference, the value was indicated for comparison by treatment means.

RESULTS AND DISCUSSION

Length of cob (cm). Among nutrient management practices, significantly longer cobs (17.45 and 18.12 cm) were recorded with the M_2[75% RDF + 25% N through vermicompost] which was on par with 75% RDF + 25% N through FYM *i.e.* M_3 (16.71 and 17.42 cm) and conspicuously shorter cobs with M_1[Control] (15.46 and 16.03 cm) during rabi 2016-17 and 2017-18. Longer cobs of 18.23 and 18.77cm were observed with S_4 [Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] and statistically equal with S_3[Atrazine 50 WP 500 g a.i ha^{-1}*fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25DAS](17.32 and 18.02cm). During both years, S_1[Control](14.67 and 15.40 cm) registered dwarf cobs. Interaction effect of nutrient and weed management practices on length of cob was not significant in zero till maize.

In addition to integrated nutrient management, soil moisture availability and congenial weather conditions increased the potential sink capacity and sink growth rate which might have increased cob length as stated by Raman and Suganya (2018); Kabira *et al.* (2021).

Higher cob length could be related to greater weed control during critical periods of crop development, allowing for lower weed density to compete with maize for growth resources, enabling photosynthates to be efficiently translocated to developing cobs as revealed by Sanodiya *et al*. (2013); Rao and Ramana (2017); Kandasamy (2018).

Girth of cob(Cm). In *rabi* 2016-17 and 2017-18 nutrient treatments, M_2 *i.e.* 75% RDF + 25% N through vermicompost resulted in maximum cob girth (14.18 and 14.93 cm) followed by M_3[75% RDF + 25% N through FYM] (13.42 and 14.18 cm), and both of them were comparable. Girth of the cobs was dramatically reduced to 11.67 and 12.19 cm with M_1[Control].

As far as weed treatments are concerned, S_4[Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] had gained the highest girth of cob (14.98 and 15.83 cm) during *rabi* 2016-17 and 2017-18, which did not differ statistically from S_3[Atrazine 50 WP 500 g a.i ha^{-1}*fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS] (14.40 and 15.14 cm). S_1[Control] measured cob's minimum girth (10.30 and 10.86 cm).

Highest cob girth presumably due to favorable vegetative growth and better translocation, utilization and partitioning of photosynthates from source to sink because of slower oxidizable nature of manures up to maturity. Similar observations were made by Pasha *et al*. (2012); Prabhat *et al.* (2018).

Excellent weed management through prolonged herbicides persistence in the soil probably resulted in improvement of total dry matter accumulation and boosted cob girth, due to proper utilization of growth factors. The results are in agreement with Rao and Ramana (2017); Kandasamy (2018).

No. of grain rows cob^{-1}. In terms of nutrient management approaches, M_2*i.e.* 75% RDF + 25% N through vermicompost gained significantly more number of grain rows cob^{-1} (12.95 and 13.15) over two years than M_1[100% RDF] (11.98 and 12.18). However, M_3[75% RDF + 25% N through FYM] had higher number of grain rows cob^{-1} *i.e.* 12.65 and 12.97, which was statistically equivalent to M_2.

The higher number of grain rows cob^{-1} was obtained with S_4[Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] (13.80 and 14.08) which was likely comparable with S_3[Atrazine 50 WP 500 g a.i ha^{-1}*fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS] (13.68 and 13.96). The next best treatment was S_2[Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24 SL 0.6 kg a.i ha^{-1}*fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS] (12.25 and 12.42). During the two-year experiment, control, *i.e.* S_1achieved the lowest number of grain rows cob^{-1} (10.38 and 10.60).

Greater availability of photosynthates, metabolites and nutrients from applied and native pool enabled timely emergence of silk and fertilization may be responsible for putting forth greater number of grain rows cob^{-1}. The other reason could be directly related to increased cob girth. These results corroborate with the findings of Parameswari (2013); Kabira *et al*. (2021).

Plant stress can reduce the actual number of grain rows produced. Improved grain rows cob^{-1} may be owing to greater translocation of photo assimilates from source to grains due to less crop weed competition even at later crop growth intervals, as a result of controlled late flushes of weeds and superior growth resources to the crop. Nidhi *et al*. (2015); Rao and Ramana (2017); Mali *et al*. (2019) found similar results.

No. of grainsrow^{-1}. Significant impact on number of grains row^{-1} was shown by nutrient management practices in two years. Highest number of grains row^{-1} (23.69 and 24.11) were obtained with M_2 *i.e.* 75% RDF + 25% N through vermicompost which was in equivalence with M_3[75% RDF + 25% N through FYM] (22.98 and 23.37). M_1[100% RDF] had shown lowest number of grains row^{-1} (21.33 and 21.77) in two consecutive years.

During *rabi* 2016-17 and 2017-18, higher number of grains row^{-1} were observed with Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice {S_4} (26.45 and 26.85) which was in parity with Atrazine 50 WP 500 g a.i ha^{-1} *fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS *i.e.* S_3(25.98 and 26.38) followed by S_2[Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24 SL 0.6 kg a.i ha^{-1} *fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS] (24.19 and 24.65) and lowest number of grains row^{-1} was realized with S_1[Control] (14.04 and 14.46).

A more balanced nutrient supply through combination of inorganic fertilizers and organic manures plays an important role due to their synergistic effect during flowering stage considerably led to the formation of higher number of grains row^{-1}. The results are in conformity with findings of Ali *et al*. (2012); Reddy *et al*. (2012); Kabira *et al.* (2021).

Higher number of grains row^{-1} possibly due to fact that increased dry matter production and distribution of photosynthates from source to sink. Similar views were expressed by Ahmed and Susheela (2012); Nidhi *et al*. (2015); Mali *et al*. (2019).

No. of cobsplant^{-1}. During *rabi* 2016-17 and 2017-18, nutrient management practices had little effect on number of cobs plant^{-1}. Almost similar no. of cobs plant^{-1} was produced by M_2[75% RDF + 25% N through vermicompost](1.05 and 1.07), M_3[75% RDF + 25%N through FYM] (1.04 and 1.05) and M_1 *i.e.* 100% RDF (1.03 and 1.04). The results are in accordance with Kabira (2021); Rao and Ramana (2017); Praveena *et al*. (2016).

Over a two-year period, there was no statistical difference among weed treatments. S_4[Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] had given rise to 1.07 and 1.11 no. of cobs plant^{-1} followed by S_3[Atrazine 50 WP 500 g a.i ha^{-1}*fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS] (1.06 and 1.07), S_2[Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24 SL 0.6 kg a.i ha^{-1} *fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS] (1.02 and 1.03) and S_1[Control] (1.0 and 1.0). These results are in consonance with those obtained by Rao and Ramana (2017); Mali *et al*. (2019).

No. of grainscob^{-1}. Number of grains cob^{-1} was significantly influenced by nutrient management practices in maize. All the nutrient treatments had registered significantly higher number of grains cob^{-1} over 100% RDF. M_2 *i.e.*75% RDF + 25% N through vermicompost recorded significantly higher total number of grains cob^{-1} (313.76 and 324.38), which was at par with 75% RDF + 25% N through FYM {M_3} (297.68 and 309.95) during both the years. However, lowest no. of grains cob^{-1} (261.20, 270.44) were realized with M_1[100% RDF].

Number of grains cob^{-1} was also significantly influenced by various weed management practices in *rabi* maize. All the weed treatments recorded significantly higher number of grains cob^{-1} over control. S_4[Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] treatment was found significantly superior with higher total number of grains cob^{-1} of 365.26 and 378.62 which was statistically similar with S_3[Atrazine 50 WP 500 g a.i ha^{-1}*fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS] (355.63, 368.54) during both years. Significantly lower number of grains cob^{-1} was observed with control (145.98,153.49).

Constant and enhanced nutrient availability resulted in taller plants and maximum dry matter accumulation, which probably increased the size of source that led to increased sink in forming the cob length, girth, no. of grain rows cob^{-1}, no. of grains row^{-1} and in turn resulted in more no. of grains cob^{-1} in zero till maize. Yadav *et al*. (2016); De and Bandyopadhyay (2013); Rao (2016), also reported same findings.

Minimum weed growth due to application of atrazine in combination with to pramezone followed by hand weeding had eliminated the crop weed competition by providing longer weed control and led to higher number of grains cob^{-1} when compared to other treatments thus improving total no. of grains cob^{-1} in maize. Similar increase in total no. of grains cob^{-1} was also noticed by Ahmed and Susheela (2012); Kandasamy (2018); Mali *et al*. (2019) due to less weed competition under farmer's practice.

Test weight(g). The test weight was not affected by any of the nutrient treatments. Out of three nutrient management practices in *rabi* 2016-17 and 2017-18, it was portrayed that 75% RDF + 25% N through vermicompost treatment registered highest test weight of 21.97 and 22.44 g followed by 75% RDF + 25% N through FYM (21.78 and 22.28 g). Lowest test weight of 21.29 and 21.86 g was observed with 100% RDF.

Over the course of two years, weed management practices had no discernible effect on test weight. Relatively higher test weight was obtained with S_4[Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] (22.06 and 22.54 g) than S_3[Atrazine 50 WP 500 g a.i ha^{-1}*fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS] (21.96 and 22.39 g), S_2[Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24SL0.6 kg a.i ha^{-1} *fb*2,4–D0.5 kga.iha^{-1} at 25 DAS](21.51and 22.09 g) and S1 [Control] (21.19 and 21.75 g).

Adequate supply of nutrients promoted meristematic and physiological activities *viz.,* leaf area, root development, crop dry matter production etc., resulting in efficient absorption and translocation of nutrients. These activities promote higher photosynthetic activities leading to the production of enough assimilate for subsequent translocation to various sinks and hence the production of higher test weight of maize. The results are in conformity with and Admas *et al*. (2015); Raman and Suganya (2018).

Higher test weight might be due to efficient translocation of photo assimilates from the source to grains and formation of more no. of grains cob^{-1} due to reduced crop weed competition even during the later stages of crop growth. Similar findings were reported by Nidhi *et al*. (2015); Rao and Ramana *et al*. (2017); Mali *et al*. (2019).

Cob weight(g). Among nutrient management practices, M_2[75% RDF + 25% N through vermicompost] had registered significantly higher weight of cob *i.e.* 90.88, 95.93 which was at par with M_3[75% RDF + 25% N through FYM] (85.51, 90.70) and lowest weight of cob was observed with M_1[100% RDF] (73.22, 77.97).

All the weed management practices in *rabi* maize significantly influenced the grain weight cob^{-1}. S_4[Topramezone 0.03kga.iha^{-1}+Atrazine 50WP 500g a.iha^{-1}at 15 DAS *fb* intercultivation/HW at 35DAS– Farmer's Practice] resulted in substantially higher grain weight cob^{-1} of 105.81 and 112.07 and at par with S_3 [Atrazine 50 WP500 ga.iha^{-1} *fb*(Topramezone 0.03kga.iha^{-1}+Atrazine50 WP 500 g a.i ha^{-1}) at 25 DAS] (102.52 and 108.43) during first and second year and significantly superior over control (40.61, 43.82).

The replacement of 25% chemical fertilizer with organic sources, *viz.,* FYM, vermicompost provided an opportunity to harness the benefit of INM practices in increased no. of grains cob^{-1} and test weight thus resulted in enhanced cob weight through better partitioning of photosynthates (Narender *et al*., 2018)

The higher cob weight might be due to greater availability of nutrients under less weed competition, which promoted higher production and translocation of photosynthates from source to sink, and thereby reflected in the improvement of cob weight. These results are in harmony with the findings of Sanodiya *et al*. (2013); Nidhi *et al*. (2015).

Cob yield ($kgha^{-1}$). Over two years, nutrient management practices had considerable impact on cob yield. Highest cob yield of 7086 and 7568 kg ha^{-1} was recorded with M_2[75% RDF + 25% N through vermicompost] followed by M_3*i.e.* 75% RDF + 25% N through FYM (6647 and 7113 kg ha^{-1}). With M_1[100% RDF], the cob yield was significantly lower (5651 and 6072 kg ha^{-1}). M_2 and M_3, on the other hand, were on par with each other.

Results pertaining to weed management practices revealed that S_4 [Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] had shown maximum cob yield of 8236 and 8805 kg ha^{-1} which was almost identical to S_3 *i.e.* Atrazine 50 WP 500 ga.i ha^{-1} *fb*(Topramezone 0.03kga.i ha^{-1} +Atrazine 50WP500 ga.iha^{-1}) at 25 DAS (7968 and 8523 kg ha^{-1}). S_2[Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24 SL 0.6 kg a.i ha^{-1} *fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS] yielded 6498 and 6926 kg ha^{-1}, respectively, compared to S_1. During two consecutive years, S_1 [Control] had the lowest cob yield of 3142 and

3416 kgha^{-1}.

Judicious use of inorganic nutrients and organic manures had the synergistic and residual effect on availability of applied nutrients in soluble form that favoured better utilization and thus increased sink capacity through better nutrient uptake by crop and boosted cob yield. These findings are consistent with those of Lakshmi *et al*. (2010); Pasha *et al*. (2012); Kumari and Sudheer (2016); Narender *et al*. (2018).

Maximum cob output may be attributable to the favourable environment offered by weed-free conditions throughout the crop growth period by rotating herbicides with multiple modes of action which resulted in good crop growth and yield potential as stated by Takim *et al*. (2014); Sanodiya *et al*. (2013); Mali *et al.* (2019).

Grain yield (kg ha^{-1}). The grain yield obtained by M_2[75% RDF + 25% N through vermicompost] treatment (5399 and 5765 kg ha^{-1}) was significantly higher and comparable with M_3[75% RDF + 25% N through FYM] (5064 and 5419 kg ha^{-1}). Over two years, M_1 [100% RDF] had the lowest grain yield of 4305 and 4626 kgha^{-1}.

S_4 *i.e.* Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice (6278 and 6707 kg ha^{-1}) engendered the highest grain yield among the weed management practices and performed equally better with S_3[Atrazine 50 WP 500 g a.i ha^{-1} *fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS] (6071 and 6494 kg ha^{-1}) followed by S_2[Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24 SL 0.6 kg a.i ha^{-1} *fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS] (4951 and 5277 kg ha^{-1}). Lowest grain yield was noticed with S_1[Control] (2394 and 2603 kg ha^{-1}). However, S_4 and S_3 were at par with each other.

Organic manures releases plant nutrients slowly to crops over time. Improvement in soil physico-chemical properties and optimum availability of nutrients and organic carbon which acted as the growth and yield enhancing characters of maize crop. Further the grain yield of maize mainly depends upon the final plant population and yield of individual plant, which in turn depends upon the number of cobs per plant and the weight of grains per cob which resulted in higher grain yield in maize. These findings are similar to those of Lakshmi *et al*. (2010); Pasha *et al*. (2012); Rao (2016); Dibakar *et al*. (2020); Sigaye *et al*. (2020); Tarun Kumar *et al*. (2021).

Curtailment in weed density and dry matter ensued efficient and longer weed control thereby reducing weed competition to crop, increased exploitation of growth resources and improved reproductive potential of the crop may have contributed to the highest grain yield. The findings are consistent with those of Rao *et al*. (2009); Srividya *et al*. (2011); Reddy *et al*. (2012); Srinivasulu *et al*. (2016); Sonali *et al*. (2018); Mali *et al*. (2019); Modak *et al*. (2019); Poojitha *et al*. (2021).

Stover yield (kgha^{-1}). A review of data on nutrient treatments in *rabi* 2016-17 and 2017-18 revealed that M_2[75% RDF + 25% N through vermicompost] (6674 and 7041 kg ha^{-1}) generated highest stover yield, followed by M_3[75% RDF + 25% N through FYM] (6339 and 6694 kg ha^{-1}) and both were statistically identical, while M_1 *i.e.* 100% RDF registered lowest stover yield of 5580 and 5901 kg ha^{-1}.

Table 1: Yield attributes of maize as influenced by nutrient and weed management practices during *rabi*, 2016-17 & 2017-18.

Treatment	Cob length (cm)		Cob girth (cm)		Number of grain rows cob^{-1}		Number of grains row^{-1}		Number of cobs plant^{-1}	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Main plots: Nutrient Management (M)										
M_1	15.46	16.03	11.67	12.19	11.98	12.18	21.33	21.77	1.03	1.04
M_2	17.45	18.12	14.18	14.93	12.95	13.15	23.69	24.11	1.05	1.07
M_3	16.71	17.42	13.42	14.18	12.65	12.97	22.98	23.37	1.04	1.05
SEm±	0.29	0.33	0.44	0.40	0.17	0.20	0.41	0.40	0.01	0.03
CD (P=0.05)	1.12	1.28	1.74	1.56	0.65	0.77	1.62	1.59	NS	NS
Sub plots: Weed Management (S)										
S_1	14.67	15.40	10.30	10.86	10.38	10.60	14.04	14.46	1.00	1.00
S_2	15.94	16.56	12.68	13.23	12.25	12.42	24.19	24.65	1.02	1.03
S_3	17.32	18.02	14.4	15.14	13.68	13.96	25.98	26.38	1.06	1.07
S_4	18.23	18.77	14.98	15.83	13.80	14.08	26.45	26.85	1.07	1.11
SEm±	0.43	0.37	0.41	0.43	0.24	0.31	0.59	0.41	0.02	0.03
CD (P=0.05)	1.26	1.09	1.22	1.28	0.72	0.91	1.76	1.21	NS	NS
Interaction										
M × S										
SEm±	0.74	0.63	0.71	0.74	0.42	0.53	1.02	0.71	0.03	0.05
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S × M										
SEm±	0.81	0.74	0.87	0.87	0.46	0.58	1.13	0.85	0.03	0.06
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Nutrient Management
M_1 - 100% RDF
M_2 - 75% RDF + 25% N through Vermicompost
M_3 - 75% RDF + 25% N through FYM

Weed Management
S_1 – Control
S_2 - Atrazine 50 WP 500 g a.i ha^{-1} + Paraquat 24 SL0.6 kg a.i ha^{-1}*fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS
S_3 - Atrazine 50 WP 500 g a.i ha^{-1} *fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS
S_4 - Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS

Table 2: Yield attributes of maize as influenced by nutrient and weed management practices during *rabi*, 2016-17 & 2017-18.

Treatment	No. of grains cob^{-1}		Test weight (g)		Cob weight (g)		Cob Yield (kg ha^{-1})		Grain yield (kg ha^{-1})		Stover yield (kg ha^{-1})	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Main plots: Nutrient Management (M)												
M_1	261.2	270.44	21.29	21.86	73.22	77.97	5651	6072	4305	4626	5580	5901
M_2	313.76	324.38	21.97	22.44	90.88	95.93	7086	7568	5399	5766	6674	7041
M_3	297.68	309.95	21.78	22.28	85.51	90.72	6647	7113	5064	5419	6339	6694
SEm±	7.48	7.86	0.32	0.46	2.20	2.26	164	169	129	145	154	158
CD (P=0.05)	29.36	30.85	NS	NS	8.63	8.86	643	662	507	569	605	619
Sub plots: Weed Management (S)												
S_1	145.98	153.49	21.19	21.75	40.61	43.82	3142	3416	2394	2603	3794	4003
S_2	296.66	305.71	21.51	22.09	83.85	88.51	6498	6926	4950	5277	6250	6577
S_3	355.63	368.54	21.96	22.39	102.52	108.43	7968	8523	6071	6494	7271	7694
S_4	365.26	378.62	22.06	22.54	105.81	112.07	8236	8805	6275	6708	7475	7908
SEm±	10.09	10.34	0.25	0.28	3.38	3.55	258	287	203	217	239	256
CD (P=0.05)	29.98	30.73	NS	NS	10.03	10.54	768	852	604	644	709	761
Interaction												
M × S												
SEm±	17.47	17.92	0.44	0.49	5.85	6.15	448	497	352	376	413	444
CD (*P=0.05*)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S × M												
SEm±	19.49	20.08	0.58	0.72	21.16	6.68	486	534	383	411	450	479
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Nutrient Management
M_1 - 100% RDF
M_2 - 75% RDF + 25% N through Vermicompost
M_3 - 75% RDF + 25% N through FYM

Weed Management
S_1 – Control
S_2 - Atrazine 50 WP 500 g a.i ha^{-1}+Paraquat 24 SL0.6 kg a.i ha^{-1}*fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS
S_3 - Atrazine 50 WP 500 g a.i ha^{-1} *fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS
S_4 - Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS

Highest stover yield of 7475 and 7908 kg ha^{-1} was yielded with S_4 [Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] and analogous to S_3[Atrazine 50 WP 500 g a.i ha^{-1}*fb* (Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1}) at 25 DAS] (7271 and 7694 kg ha^{-1}). However, as compared to S_1[Control], S_2[Atrazine 50 WP @ 500 g a.i ha^{-1} + Paraquat 24 SL 0.6 kg a.i ha^{-1}*fb* 2,4 – D 0.5 kg a.i ha^{-1} at 25 DAS] (6250 and 6577 kg ha^{-1}) was superior (3794 and 4003 kg ha^{-1}).

Increased stover output might be attributed to slightly different action of vermicompost or FYM substitution may be because of slow release of nutrient availability due to mineralization, which led to faster cell elongation, as well as greater leaf area and synthesis of photosynthates, which resulted in increased dry matter. Reddy *et al*. (2012); Radha and Sudheer (2016); Abid *et al*. (2020); Dibakar *et al*. (2020) reported similar findings.

Better weed management through integration of herbicides followed by inter cultivation and hand weeding might have aided crop growth, allowing for better dry matter output and enhanced stover yield. Rajbir and Yadav (2018); Mali *et al*. (2019) found similar results.

CONCLUSIONS

Maize grown under zero till condition after semi dry rice resulted in enhanced yield parameters *viz.,* cob length, cob girth, number of grains row^{-1}, number of grain rows cob^{-1}, number of grains cob^{-1}, cob weight, cob yield, test weight, cob weight, grain and stover yield with 75% RDF + 25% N through vermicompost. Among different weed management practices imposed in zero till maize, S_4 [Topramezone 0.03 kg a.i ha^{-1} + Atrazine 50 WP 500 g a.i ha^{-1} at 15 DAS *fb* intercultivation / HW at 35 DAS – Farmer's Practice] recorded higher yield attributes.

FUTURE SCOPE

Persistence and dissipation behavior of new generation herbicides for rice-maize system have to be worked out.

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