RESEARCH ARTICLE

# PRODUCTION, PRODUCTIVITY AND PROFITABILITY OF MAIZE (*ZEA MAYS*) AS INFLUENCED BY DIFFERENT AGRONOMIC PRACTICES

**Urmila Painkra*, P.K. Bhagat, A.K. Paliwal, V.K. Singh and A. K. Sinha**

*RMD College of Agriculture and Research Station, Indira Gandhi Krishi Vishwavidyalaya Ambikapur, Surguja- 497001 (Chhattisgarh)*
*Email: amitksinha11@gmail.com*

*Received-03.01.2020, Revised-25.01.2020*

**Abstract:** A field experiment was carried out during the *kharif* season of 2018-19 at Research farm, Ambikapur, to study the effect of different agronomic management practices on production, productivity and profitability of maize. Different treatment combinations were included in the experiment viz. farmers' practice, ecological intensification (EI), EI- tillage practices, EI-nutrient management, EI- planting density, EI- water management, EI- weed management and EI- disease and insect management laid out in randomized block design and replicated thrice. The mean loss in kernel yield of maize due to EI- weed management was 28.76%. Ecological intensification recorded higher yield and yield attributes significantly higher over rest of the treatments. Ecological intensification recorded significantly minimum total weed density (7.94 $m^{-2}$) and weeds dry weight (3.98 g) as compared to all other treatments and recorded highest kernel and stover yield.

**Keywords:** Ecological intensification, Maize, Kernel yield, Weed management

## INTRODUCTION

Maize (*Zea mays* ) popularly known as "Corn" is one of the most versatile emerging cash crop having wider adaptability under varied climate condition and globally, it is called "Queen of cereal" because of it has highest genetic yield potential. Maize is one of the most important cereal crops in the world, ranked third after wheat and rice and contributes to the nearly 9% of the national food basket (Jeet *et al.,* 2014).

Although India is well placed in meeting its need for food grains. The major objective of food and nutritional security for its entire population has not been achieved. Agricultural production depends on various factors and any set back in these factors severely affects the yield of crop. Tillage management, nutrient management, Planting Density, water management, weed management, and plant protection management are the most important factors influencing crop production, eco-environment and sustainability in agricultural production. Continuous use of modern techniques of agricultural production has some drawbacks like over use of chemicals leads to soil and water pollution, use of heavy machines in the field results in soil compaction, deteriorate the soil structure and reduces infiltration rate leads to run off and soil erosion.

Ecological intensification is the process of improving both yields and environmental performance of crop production with a focus on precise management of all production factors and maintenance or improvement of soil quality. The terms ecological intensification and sustainable intensification were first coined in the late 1990s (Cassman, 1999 and Pretty, 1997). Ecological intensification comprises of best tillage and residue management practices; best planting density and genotype; precision nutrient management based on nutrient expert, application of water at critical growth stages; integrated weed, disease and insect management. Therefore, the present experiment was undertaken to find out the effect and extent loss due to different agronomical practices on the production, productivity and profitability of maize in Northern Hill region of Chhattisgarh.

## MATERIALS AND METHODS

The present investigation entitled ''Production. Productivity and profitability of maize (*Zea mays*) as influenced by different Agronomic practices'' was conducted during *kharif* season 2018-19 at Research farm of RMD College of Agriculture and Research Station, Ambikapur situated at 230 18' N latitude and 830 15' E longitude and at altitude of 623 meter above mean sea level. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.7), medium in organic carbon (0.56), available nitrogen (234 kg ha-1), available phosphorus (8.4 kg ha-1) and available potassium (268 kg ha-1). The experiment was laid out in randomized block design with 8 treatments replicated thrice. Treatments are farmers' practice, ecological intensification (EI), EI-tillage practices, EI-nutrient management, EI-planting density, EI- water management, EI- weed management and EI- disease and insect management. Field preparation was done as per treatment. In farmers' practice treatment, experimental plots were ploughed once with tractor drawn cultivator and leveled by harrowing whereas in ecological intensification treatments, experimental plots were deep ploughed twice with tractor drawn cultivator and leveled by harrowing to obtain fine tilth. Sowing and spacing were made as per treatment. Maize var. "JK super 502" was sown in lines at a spacing of 50

*Corresponding Author

X 20 cm in farmers' practice treatment, whereas 60 X 20 cm in ecological intensification treatments. Nutrient management was done as per treatment. In farmers' practice treatment, fertilizers were applied in experimental plots @ 120:60:40 kg $ha^{-1}$(N: P: K)whereas in ecological intensification treatments, SSNM based fertilizers were applied in experimental plots @ 170:67:87 kg $ha^{-1}$ (N: P: K).In farmers' practice treatment, one third nitrogen, full dose of $P_2O_5$ and K2O were applied as basal at the time of sowing and remaining nitrogen was top dressed in two equal splits at Knee high stage (30 DAS) and at tasseling stage (50 DAS). In ecological intensification treatments, one fourth nitrogen and entire dose of $P_2O_5$ and K2O were applied as basal dose at the time of sowing by placement method. The Remaining nitrogen was applied as top dressing in three equal splits at Knee high stage (30 DAS), tasseling stage (50 DAS) and seed setting (65 DAS) equally as per treatments. Weed management was done as per treatment. In farmers' practice treatment, Atrazine was applied as pre-emergence in experimental plots @ 1 kg *a.i.* $ha^{-1}$ whereas in ecological intensification treatments, Atrazine was applied as pre-emergence @ 1 kg *a.i.* $ha^{-1}$fb Tembotrione 120 g *a.i.* $ha^{-1}$ as post-emergence 25 DAS. Weed count and weed dry weight was recorded at 60 DAS randomly at 2 places in each plot. Data on weed population and weed dry weight subjected to square root transformation because of wide variations. Plant protection was made as per treatment. In farmers' practice treatment, no plant protection measures were adopted whereas in ecological intensification treatments, Phorate 10 G (2-3 granules) were applied in the leaf whorl to control stem or shoot borer in each plant at 30 DAS. Five random plants were tagged randomly from each plot for recording of growth and yield attributes. Gross returns, net returns and benefit: cost ratios were calculated on the basis of prevailing market price of inputs and produce. All data obtained in the was statistically analyzed using *F*- test, the procedure given by Gomez & Gomez (1984), critical difference (CD) values at *P*= 0.05 were used to determine the significance of differences between means.

## RESULT AND DISCUSSION

**Yield attributes**

Yield attributes viz., cob length (cm), cob girth (cm), no. of kernel rows $cob^{-1}$, no. of kernels $row^{-1}$ and 100 kernel weight were significantly affected due to various agronomical practices (Table 1). Data revealed that ecological intensification ($T_2$) recorded higher yield attributes found at par with $T_6$ i.e., EI-water management, $T_8$ i.e., EI-insect & disease management found significantly superior over $T_3$ i.e., EI- tillage practices, $T_5$ i.e., EI- planting density, $T_1$ i.e., farmer practices, $T_4$ i.e., EI- nutrient management and $T_7$ i.e., EI-weed management. Lower yield attributes were recorded under $T_7$ i.e., EI-weed management as compared to other management practices.

**Weed dynamics and dry weight**

Different agronomical practices significantly affected the weed density and their dry weight (Table 1). Ecological intensification had minimum weed density and their dry matter showed parity with $T_6$ i.e., EI- water management, $T_8$ i.e., EI- insect and disease management, $T_3$ i.e., EI- tillage management, $T_4$ i.e., EI- nutrient management and $T_5$ i.e., EI-planting density. The maximum total weeds dry matter was recorded with $T_7$ i.e., EI-weed management followed by $T_1$ i.e., farmers' practices and both of these treatments were significantly inferior to other treatments.

Weeds always compete with crop for nutrient, water and light which significantly affect the growth and development of crops and ultimately reduced the yield up to 42% depending upon the severity of weed infestation. The findings of present study revealed that total weed density was recorded higher under EI-weed management followed $T_1$ i.e., farmers' practices where only pre-emergence herbicide atrazine were applied but in ecological intensification and other treatments tembotrione was also used as post emergence at 25 DAS. Ecological intensification treatment had significant impact on weed density as well as total weeds dry weight at 60 DAS. In latter stage of crop growth, some weeds were germinated as $2^{nd}$ or $3^{rd}$ flush but there was no side effect due to these weeds and they are suppressed due to plant canopy. Findings are in conformity with the finding of Barua *et al.* (2019).

**Table 1.** Yield attributes and weed dynamics in maize as influenced by different agronomical practices

| Tr. No. | Treatment | Yield attributes | | | | Weed density | | | | Total weeds dry weight ($m^{-2}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Cob length (cm) | Cob girth (cm) | No. of kernel rows/cob | No. of kernels/ row | Grassy Weeds ($m^{-2}$) | Broad-leaf ($m^{-2}$) | Sedge ($m^{-2}$) | Total weeds ($m^{-2}$) | |
| $T_1$ | Farmer's Practices | 12.37 | 12.30 | 10.80 | 24.33 | 8.30 (68.53) | 6.28 (39.00) | 4.76 (22.20) | 3.05 (8.83) | 4.70 (21.59) |
| $T_2$ | Ecological Intensification | 18.73 | 13.44 | 13.47 | 36.73 | 5.03 (24.93) | 4.50 (19.80) | 3.74 (13.53) | 2.20 (4.36) | 3.98 (15.39) |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $T_3$ | EI - Tillage practice | 15.47 | 12.75 | 12.47 | 31.40 | 5.40 (28.67) | 4.73 (21.93) | 3.91 (14.80) | 2.41 (5.30) | 4.23 (17.42) |
| $T_4$ | EI-Nutrient Management | 11.93 | 11.90 | 9.93 | 25.93 | 5.44 (29.07) | 4.81 (22.67) | 3.96 (15.23) | 2.58 (6.23) | 4.18 (17.01) |
| $T_5$ | EI- Planting Density | 14.23 | 12.50 | 12.13 | 27.93 | 5.38 (28.53) | 5.26 (27.17) | 3.95 (15.13) | 2.42 (5.37) | 4.28 (17.82) |
| $T_6$ | EI- Water Management | 18.30 | 13.20 | 13.33 | 34.00 | 5.14 (25.93) | 4.53 (20.07) | 3.85 (14.30) | 2.23 (4.47) | 4.12 (16.45) |
| $T_7$ | EI- Weed Management | 10.23 | 9.74 | 9.47 | 23.00 | 9.83 (96.13) | 7.66 (58.20) | 6.61 (43.33) | 4.32 (18.20) | 7.09 (49.86) |
| $T_8$ | EI- Disease and Insect Management | 17.35 | 12.91 | 13.17 | 33.07 | 5.25 (27.13) | 4.80 (22.53) | 3.86 (14.43) | 2.28 (4.73) | 4.23 (17.38) |
| Sem± | | 0.67 | 0.52 | 0.41 | 1.28 | 0.14 | 0.12 | 0.10 | 0.11 | 0.10 |
| C.D. (0.05) | | 2.05 | 1.59 | 1.26 | 3.90 | 0.44 | 0.37 | 0.30 | 0.34 | 0.40 |

Note: Data in parenthesis (original value) was subjected to $\sqrt{X + 0.5}$ transformations.

**Yield**

The kernel, stover yield and HI (%) were significantly influenced due to different agronomical practices (Table 2). The grain yield was found to significantly influenced due to different treatments. The treatment $T_2$ i.e., Ecological intensification recorded maximum yield and harvest index closely followed by $T_6$ i.e., EI- water management, $T_8$i.e. EI- insect and disease management and these treatments were found significantly superior to $T_3$ i.e., EI-tillage practices,$T_5$ i.e., EI-plant density,$T_1$ i.e., farmer practices,$T_4$ i.e., EI- nutrient management and$T_7$ i.e., EI- weed management. The minimum yield and harvest index were obtained from $T_7$ i.e., EI- weed management.

The yield is the function of interplay of yield attributes and the growth characters. The grain yield of maize depends on the cob length, cob girth, number of rows $cob^{-1}$, number of kernels $row^{-1}$and 100 grain weight. Yield attributes of maize were significantly influenced by adapting different management practices and higher value were noticed under treatments with best all best agronomical management practices i.e., ecological intensification provided with sufficient water, nutrient management based on site specific nutrient management, better plant spacing, lower weed density. The yield attributes *viz.*, cob length, cob girth number of rows $cob^{-1}$, number of kernels $row^{-1}$and 100 grain weight were found higher with $T_2$ i.e., Ecological intensification as well as under $T_6$ i.e., EI- water management over rest of the all treatments. This result is found to be in close conformity with Mukherjee (2014) Barod *et al.* (2012).

**Economics**

Different Agronomical practices had significant influence on net return and benefit: cost ratio.Net return was significantly affected due to various treatments. Maximum net return were obtain under treatment $T_2$ i.e., Ecological intensification (Rs. 56548.20) which was at par with $T_6$ i.e., EI- water management (Rs.52125.07) and $T_8$ i.e., EI- Disease and insect management (Rs. 49827.08) and all these treatments were found significantly superior over $T_3$ i.e., EI- tillage practices (Rs. 42495.74), $T_1$ i.e., farmers' practices (Rs. 36790.46), $T_5$ i.e., planting density (Rs. 34291.93), $T_4$ i.e., EI- nutrient management (Rs. 29144.00) and Minimum net return was obtained with $T_7$ i.e., EI- weed management (Rs. 12404.90).

The maximum benefit cost ratio was noticed under $T_2$ i.e., Ecological intensification (1.33) which remained on par with $T_6$ i.e., EI- water management (1.25) followed by $T_8$ i.e., EI- Disease and insect management (1.19) but significantly superior over $T_3$ i.e., EI- tillage practices (1.07), $T_1$ i.e., farmers' practices (0.95). $T_5$ i.e., planting density (0.78), $T_4$ i.e., EI- nutrient management (0.68) and Minimum benefit cost ratio was obtained with $T_7$ i.e., EI- weed management (0.30).

The practical utility of any treatment can be best judged because of net return and B:C ratio. Ecological intensification treatment showed significant direct yield advantage over EI- weed management in maximizing net return as well as B:C ratio. All the management practices provided more net return than that of EI- weed management and farmers' practices. It was also observed that all the management treatments were more beneficial as compared to EI- weed management and farmers' practices. This was because of more net returns than the money spent in crop production under these treatments. These results are found to be in close conformity with Upasani *et al.* (2017) and Prasad *et al.* (2014).

## CONCLUSIONS

It can be concluded that ecological intensification was most effective to enhance yield attributes and yield of maize which was at par with EI- water management, EI – disease and insect management

and EI- Tillage practice and significantly superior over rest of the treatments. EI- weed management treatment reduced the yield attributes and yield of maize at higher extent upto 28.76%. EI- weed management recorded lowest BC ratio that is one of the important factor which caused maximum loss.

**Table 2.** Yield and economics of maize cultivation as influenced by different agronomical practices

| Treatment | | Kernal Yield (Kg ha$^{-1}$) | Stover Yield (Kg ha$^{-1}$) | Harvest index (%) | Net return (Rs) | BC ratio |
|---|---|---|---|---|---|---|
| $T_1$ | Farmers' Practices | 5044.44 | 15081.21 | 31.37 | 36790.46 | 0.95 |
| $T_2$ | Ecological Intensification | 6745.11 | 17225.07 | 35.56 | 56548.20 | 1.33 |
| $T_3$ | EI- Tillage practice | 5548.88 | 15651.82 | 31.28 | 42495.74 | 1.07 |
| $T_4$ | EI-Nutrient Management | 4815.55 | 13993.30 | 31.31 | 29144.00 | 0.68 |
| $T_5$ | EI- Planting Density | 5275.55 | 15203.43 | 31.56 | 34291.93 | 0.78 |
| $T_6$ | EI- Water Management | 6348.00 | 16720.09 | 34.27 | 52125.07 | 1.25 |
| $T_7$ | EI- Weed Management | 3593.33 | 10301.42 | 30.30 | 12404.90 | 0.30 |
| $T_8$ | EI- Disease and Insect Management | 6191.55 | 16066.55 | 33.15 | 49827.08 | 1.19 |
| Sem± | | 220.98 | 842.74 | 0.59 | 3438.98 | 0.08 |
| C.D. (0.05) | | 660.61 | 2556.45 | 1.81 | 10432.1 | 0.26 |

## REFERENCES


**Barod, N.K., Dhar, S. and Kumar, A.** (2012). Effect of nutrient sources and weed control method on yield and economics of baby corn (*Zea mays*) . *Indian Journal of Agronomy* 57(1): 96-99.

**Barua, S., Lakra, A. K., Bhagat, P. K. and Sinha, A. K.** (2017). "Weed dynamics and productivity of Maize (Zea mays L.) under pre and post emergence application of herbicide." *Journal of Plant Development Sciences* 11(7): 409-13 (July, 2019).

**Cassman, K. G.** (1999). Ecological intensification of cereal production system: Yield potential, soil quality, and precision agriculture. *Proceeding of the National Academy of Science of the United State of America*. Vol. 96 (11): 5952-5959.

**Gomez, K.A. and Gomez, A. A.** (1984). Statistical procedure for Agricultural Reseach., edn 2, John Wiley & Sons, New York pp. 241-271.

**Jeet, S., Singh, J.P., Kumar, R. and Om Hari** (2014). Response of nitrogen and sulphur levels on productivity and profitability of QPM hybrid (Zea mays L.) under dryland condition of Eastern Uttar Pradesh. *Indian J. Agri. Sci.*, 84(5): 589-594

**Mukherjee, D.** (2014). Influence of integrated nutrient management on productivity, nutrient uptake and economics of maize (*Zea mays*) – yellow sarson (*Brassica rapa*) cropping system under rainfed mid hill condition. *Indian Journal of Agronomy* 59(2): 221-228.

**Prasad, D., Rana, D.S., Rana, K.S. and Rajpoot, S.A.** (2014). Effect of tillage practices and diversification on productivity, resource – use efficiency and economics of maize (*Zea mays*)/soybean (*Glycin max*)-based cropping system. *Indian Journal of Agronomy* 59(4): 534-541.

**Pretty, J.** (1997). Sustainable intensification in agriculture system. *Annals of Botany* page 1-26

**Upasani, R.R., Barla, S. and Puran, A.N.** (2017). Effect of tillage and weed control method in maize (*Zea mays*) – wheat (Triticum aestivum) cropping system. *International Journal of Bio- resources and Sterss Management* .8(6): 758-766.