ISSN (E): 2583 – 0821

Sun. Agri.:e-Newsletter, (2022) *2*(4), 1-4

Article ID: 124

Benefits of Slow Release N fertilization under Conservation Agriculture in *Kharif* maize (*Zea mays* L.)

Bharat Raj Meena[1*], S.L. Jat[2], C.M. Parihar[3], Bheru Lal Kumhar[4], Satyanarayan Regar[5], Radheshyam[1]

[1]Ph.D. Research Scholar, ICAR-Indian Agricultural Research Institute, New Delhi
[2]Sr. Scientist, ICAR-Indian Institute of Maize Research, Delhi Unit
[3]Sr. Scientist, ICAR-Indian Agricultural Research Institute, New Delhi
[4] Research Associate, ICAR-Central Arid Zone Research Institute, Jodhpur
[5]Ph.D. Research Scholar, Agriculture University, Kota

Open Access

*Corresponding Author
Bharat Raj Meena*

Available online at
www.sunshineagriculture.vitalbiotech.org

Article History
Received: 5.04.2022
Revised: 14.04.2022
Accepted: 18.04.2022

This article is published under the terms of the Creative Commons Attribution License 4.0.

INTRODUCTION

Maize is the third most important cereal in the world and is grown in wide agro-ecologies in 155 nations. It is often referred to as "Queen of cereals, back bone of America and miracle crop. The ideal daytime temperature for maize varies from 26^{0}C to 30^{0}C, but it can tolerate higher temperatures if assured irrigation facilities are available. Night-time temperatures above 21^{0}C can result in wasteful respiration in maize. The optimum soil temperatures for germination and early seedling growth are 12 ^{0}C or greater while at tasseling 21 to 30 ^{0}C is ideal. It can grow and yield with as little as 300 mm rainfall, but prefers 500 to 1,200 mm as the optimal range. Depending on soil type and stored soil moisture, crop failure would be expected if less than 300 mm of rainfall were received. It is a tropical grass adapted to diverse climates and hence has wide-ranging maturity duration from 70 to 210 days.

In India, the maize cultivated area is about 9.57 mha with productivity of 3.01 t/ha and total production of 28.77 million tons (DACNET, 2021). India's maize productivity is lower than the global average of 5.82 t/ha (FAOSTAT, 2021). In terms of regional distribution, top 5 states which contribute 55% of India's total maize production are Madhya Pradesh (15%), Karnataka (14%), Tamil Nadu (10%), Bihar (9%) and Telangana (8%). In India, *kharif*/rainy is the main season for maize cultivation, contributing to more than 80% of the acreage and about 70% of production. The bulk of the maize production in India, approximately 47%, is used as poultry feed. Of the rest, 14% is used in the starch industry, 13% is used as livestock feed, 13% for food purposes, 7% as processed food and 6% for export and other purposes (IIMR, 2021). There is a tremendous need to increase the acreage and productivity of this crop in near future to meet rising feed, food and industrial demands, especially in view of the very fast growth in livestock and poultry sectors in India.

ISSN (E) : 2583 – 0821

Growth and yield of any crop under a particular environment are largely governed by soil moisture, inherent nutrient supplying capacity, solar radiation interception and the efficiency of conversion of intercepted radiation and partitioning of dry matter to grain.

One hundred grams of fresh corn-grain contain 361 calories of energy, 9.4 g protein; 4.3 g fat, 74.4 g carbohydrate, 1.8 g fiber, 1.3 g ash, 10.6% water, 140 mg vitamins, 9 mg calcium, 290 mg phosphorus and 2.5 mg iron. It is a source of raw material for industries, where it is being extensively used for the preparation of corn starch, corn oil, dextrose, corn syrup, corn flakes, cosmetics, wax, alcohol and tanning material. Maize is consumed as second-cycle produce converted into meat, eggs and dairy products in high-income economies. In developing countries, it is consumed directly and serves as a staple diet for around 200 millions people and it is regarded as a breakfast cereal. It is also found as fuel (ethanol) and starch in processed forms. Starch is used to make products such as sorbitol, dextrine, sorbic and lactic acid by enzymatic reaction, and appears in household items.

In pre-green revolution era, coarse cereals including maize were the principal crops of rainy season in northern India. But with the introduction of high yielding varieties and expansion of irrigation facilities, rice has become the prominent rainy season crop while wheat as winter crop after green revolution. Hardly less than one tonne organic manure per ha is being added to the soil, which leads to fast decline in organic matter content of soils. The groundwater depletion due to overexploitation for planting of rice, as it is done in north-western Indo-Gangetic plains (IGP) two months before onset of monsoon and that has dangerously lowered the water level. Moreover, in command areas due to excessive and indiscriminate use of irrigation water, salinity is building up. The genetic homogeneity both at varietal and crop levels enhanced genetic vulnerability to biotic stresses *e.g.* frequent outbreak of stem borer, white backed plant hopper and leaf folder in rice, which pose the risk of pesticide resistance due to heavy chemical use in an unscientific manner. Besides, some environmental and economic problems such as development of hardpans, low input-use efficiency including water, environmental pollution through emission of gases and large-scale burning of rice straw are evident problems under the rice-wheat cropping system belt. Economically, it is becoming less and less profitable because of increasing input costs; particularly conventional tillage practices. Therefore, identification of suitable crops and cropping systems and developing the technologies that can reverse the process leading to resource degradation urgently needed. Conservation agriculture (CA) has emerged as a major way forward to improve and sustain the soil health, crop productivity and farm profitability. The escalating prices of the agricultural inputs going to affect the crop production cost due to use of diesel in agriculture on one hand and higher fertilizer and agrochemical prices on other hand. Recently, CA practices for crop production consisting of minimum soil mechanical manipulation, permanent soil cover and profitable crop rotation found to be useful in reducing the cost of crop production in addition to giving ecological services for lower carbon consumption/emission. Due to these benefits, the area under CA has expanded from 45 mha to 180 mha in the period from 1999 to 2015 (Kassam *et al.*, 2019). However, in India, the area under CA is limited to only 1.5 mha (Kassam *et al.*, 2019). Adoption of CA in South Asia has a skewed distribution concentrated mainly in the Indo-Gangetic Plains belt (IGP) spreading over India, Pakistan, Nepal and Bangladesh. So, large-scale CA adoption is required in India to harness more environmental and social benefits along with productive soils and profitable sustainable farming.

Copyright © April, 2022; Sunshine Agriculture

A short-duration dual purpose grain legume (e.g. mungbean) provides another option in cereal-based cropping systems of IGP to improve soil health besides increasing profits in crop production. Cost intensive tillage based crop production technologies are less water efficient and detrimental to soil health compared to CA. Earlier studies in IGP, showed that crop yields, water productivity, and economic sustenance in various cropping systems can be increased by CA practices (Jat *et al.,* 2014). Tillage practices enhance the soil drying and heating/cooling processes as it disturbs the soil surface and thus increases the loss of N from the soil by volatilization resulting in lower N-use efficiency (NUE). Residue increases surface soil moisture and near the surface C source to microbes where high soil temperature favours denitrification which results in a closer zone of denitrifying activity in ZT than other tillage practices.

Even with the high N rate application @ 130-160 kg/ha, fertilizer N recovery by cereals is rarely greater than 50%. Both surface residue retention and ZT potentially induce major changes in N dynamics and thus require a differential N management strategy compared to the conventional system. While ZT may reduce N mineralization by decreasing decomposition of soil organic matter, particularly in the initial 3–4 years of CA-adoption, crop residues can influence N dynamics from immobilization and volatilization.

However, broadcasting nitrogen fertilizer over the crop residues can be an inefficient method because of N immobilization and greater ammonia volatilization associated with the microbial breakdown of cereal residues than when applied to the bare soil surface. The recovery efficiency of N can also be influenced by weather variation, choice of the crop, N sources and application methods.

Despite more favourable results of CA in research, farmers are not adopting it at their fields due to several reasons and one of them is improper nutrient especially N management practices. The five-split application of N in maize with recommended dose of nitrogen in ratio of 10:30:30:20:10 as basal, 4-leaf emergence, 8-leaf emergence, tassel emergence and early grain filling stages, respectively enhances the grain yield as compared to three split application (Singh, 2010). But at the same time split application incurs more labour wage as compared to one time application and already there is shortage of labour in Indian agriculture. Moreover, the residue retention on the soil surface under CA becomes a hurdle for split-urea application and lowers the N-use efficiency as part of it is either volatilized or immobilized due to fraction of applied fertilizer resting on the residue and consumed by the microbes. For enhancing profitability in maize-based systems through CA, there is a need to enhance fertilize N-use efficiency through use of slow release N fertilizers which will also act as a panacea for labour shortage in agriculture. Hence, proper management practices require enhancing NUE and reducing environmental footprints in the CA system. So, the review suggests that there is a need for proper N management practices to accelerate the adoption of CA. A field study was conducted to evaluate the effect of different N source, *viz.,* prilled urea (PU), sulphur coated urea (SCU) and neem coated urea (NCU), on soil health, NUE, crop productivity and farm profitability in two cropping systems *viz.,* maize-mustard-mungbean (MMuMb) and maize-wheat-mungbean (MWMb) under conservation agriculture during *kharif* 2015 in an ongoing long-term experiment since 2012 at New Delhi. Key findings from the experiment were as follow; significantly superior yields *viz.,* stover (10589 kg/ha) and grain yield (5786 kg/ha) under MWMb, while, cobs (8382 kg/ha), stover (11989 kg/ha) and grain (6701 kg/ha) by application of NCU were recorded. Higher NUE along with enhancement in water productivity and its efficiency were recorded with NCU

ISSN (E) : 2583 – 0821

application and MWMb under CA-based plots. The increase in mineral N at various crop growth stages and other nutrients availability at harvest (Fe, Zn, Cu and K) was also found in MWMb and NCU plots. The soil microbial biomass carbon and enzymatic activities were also recorded significantly higher under CA at flowering and at harvest stage of the crop.

Similarly, MWMb cropping system enhanced the net returns and benefit-cost ratio to the tune of 13.0 and 12.7 per cent, respectively over the MMMb. Significantly highest net returns (₹77153) and BC ratio (₹3.27 earned per rupee invested) were obtained by the application of neem coated urea (NCU). It was concluded that one time basal application of coated urea and residue retention significantly improved the crop yield, farm profitability, resource-use efficiency and soil health in maize under conservation agriculture besides reducing the cost of cultivation.

REFERENCES

DACNET. 2021. Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India. https://eands.dacnet.nic.in/, Accessed on 08th September 2021.

FAOSTAT. 2021. Food and Agriculture Organization, Rome, Italy. http://www.fao.org/faostat/en/#data, Accessed on 8th September 2021.

IIMR. 2021. Indian Maize Scenario. https://iimr.icar.gov.in/india-maze-scenario/ Accessed on 13th Spetember, 2021.

Kassam, A., Friedrich, T. and Derpsch, R. 2019. Global spread of conservation agriculture. *International Journal of Environmental Studies* 76: 29–51.

Jat, R.K., Sapkota, T.B., Singh, R.G., Jat, M.L., Kumar, M. and Gupta, R.K. 2014. Sevenyears of conservation agriculture in a rice-wheat rotation of eastern Gangetic Plains of South Asia: yield trends and economic profitability. *Field Crops Research* 164: 199–210.

Singh, D. 2010.Impact of scheduling nitrogen on productivity of single cross maize (*Zea mays*) hybrids. *Indian Journal of Agricultural Sciences* 80(7): 649–651.

Copyright © April, 2022; Sunshine Agriculture