Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(6): 135-137
Received: 14-09-2021
Accepted: 18-10-2021

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Agronomical performance of kharif maize (*Zea mays* L.) under the effect of organic and inorganic fertilizers

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Abstract
A field experiment was conducted during kharif season of 2019 at the Research farm, ITM University, Gwalior to study the "Agronomical performance of kharif maize (*Zea mays* L.) Under the effect of organic and inorganic fertilizers". RDF(0, 50 and 100 kg ha^{-1}) and VC(0, 5 and 10 kg ha^{-1} Vermicompost (VC) with nine treatment combinations tested in factorial randomized block design with three replications. Results indicated that application of 100 kg RDF ha^{-1} recorded the maximum germination percentage (87.84%) plant population (5.95), plant height (178.39cm), number of leaves (15.84),fresh weight (298.07gm), dry weight (48.19gm), number of cobs (1.53), cob length (12.63cm), cob girth(7.55cm), cob weight with kernels (116.24gm), cob weight without kernels (44.56gm), number of kernels per plant (342.62), weight of kernels (71.68gm), seed index (18.04gm), grain yield (46.95q/ha), stalk yield (57.52q/ha), biological yield (104.48q/ha), harvest index (44.91%), protein content (11.42%), cost of treatment (21300.00Rs/ha), gross monetary returns (77609.3Rs/ha), net monetary returns (56309.3Rs/ha), B:C (2.64).

Keywords: Maize, inorganic and organic

Introduction
Maize (*Zea mays* L.) is one of the important cereal crop of the world, known as "queen of cereals" due to its great importance in human and animal diet and is very efficient utilizer of solar energy and has immense potential for higher yield. Maize is the crop of future as mentioned by Father of Green revolution renowned nobel Laureate Dr. Norman E. Borlaug. It plays a vital role in ensuring food security as well as nutritional security through quality protein. Maize (*Zea mays* L.) ranks third in total world production after wheat and rice and it is principal staple food in many countries, particularly in the tropics and subtropics. Being a C4 plant, it is capable to utilize solar radiation more efficiently even at higher radiation intensity. Maize assumes a special significance in Indian agriculture on account of its utilization as food, feed and fodder besides several industrial uses. Nitrogen, phosphorus and potassium are essential elements and important determinant of plant growth and development. Nitrogen is a component of protein and nucleic acids and when N is sub-optimal, growth is reduced. Its availability in sufficient quantity throughout the growing season is essential for optimum maize growth. Potassium is a vital plant nutrient and a major yield determining factor required for maize production. Grain yield was increased significantly with different levels of N, P and K applications in maize plants. Phosphorus plays a key role in energy transfer and is essential for photosynthesis and other chemico-physiological processes in plants. Application of organic materials along with inorganic fertilizers in the soil leads to sustained productivity and also vermicomposting technology involves the bio-conversion of organic waste into vermicasts and vermiwash utilizing earthworms (Palanichamy *et al*., 2011) [7]. Vermicompost is a nutrient rich organic fertilizer and soil conditioner, by addition of vermicompost in soil it increases the soil physical, chemical as well as bio logical properties. (Ashokan, 2008) [1]. Bio fertilizers play an important role in the increasing availability of nitrogen and phosphorus.

Material and Method
The present investigation entitled the "Agronomical performance of kharif maize (*Zea mays* L.) Under the effect of organic and inorganic fertilizers" was carried out at the Agriculture Research Farm, School of Agriculture, ITM University, Gwalior, (M.P.) during the year 2019-20. The research farm is located at latitude of $26^{0}14'$ N and longitude of $78^{0}14'$ E with an elevation of 206 m above the mean sea level. The soil is categorized as sandy clay loam with low aggregation. Soil of the experimental field was low in organic carbon, available inorganic and medium in available RDF and potash contents.

It is slightly alkaline in reaction and had moderate cation exchange capacity. The experiment was laid out in a Factorial Randomized Block design replicated three times with three levels of Inorganic scheduling (0, 50, and 100 kg/ha) and three levels of Organic (0, 5, 10 kg/ha) thereby making nine treatment combinations. The treatments were randomized as per statistical procedure. The seed of maize, Chetak variety were sown on the furrow on July, 24th 2020 and the furrows were covered by soils soon after seeding. Seeds were treated with Thiram @ 2 g/kg of seed, before sowing the seeds to control the seed borne disease. The seeds were sown continuously in 75.0 cm apart rows at about 4-5 cm depth in afternoon and covered with soil. The weighed quantities of Inorganic as per treatment and prescribed levels of vermicompost for each plot/treatment).Urea and Single Super Phosphate (SSP) was used as a source of inorganic, phosphorous, respectively. Inorganic was applied in the form of urea, as basal at the time of sowing in every plot. Inorganic and vermin compost was applied as basal dressing at the time of sowing in every plot in the experimental field as per the treatments. Fertilizers were applied by placement i.e., 5 cm away from seed row and of 5 cm below the seed zone. All other cultural practices were uniform for all treatments. Crop was harvested at complete maturity as judged by visual observations. Harvesting was done when moisture content of grains varies from 17-20 %. Prior to harvesting of experimental crop border rows were harvested and removed first from experimental plot and kept aside then three randomly tagged plants from each plot of the crop were taken out for recording post-harvest scheduled observations. Thereafter, the net plot was harvested manually. The crop was left in the respective plots for 7 days for sun drying. Total biological yield was recorded after sun drying in each experimental plot. The total dry weight of bundles (biological yield) of net plot was recorded plot-wise just before threshing and finally threshing was done by manual labour.

Results and Discussion

Effect of inorganic Growth parameters, yield attributes and yield of maize viz., maximum germination percentage plant population, plant height, number of leaves, fresh weight, dry weight, number of cobs, cob length, cob girth, cob weight with kernels, cob weight without kernels, number of kernels per plant, weight of kernels, seed index, grain yield, stalk yield, biological yield, harvest index protein content, cost of treatment, gross monetary returns, net monetary returns, B:C were significantly influenced by inorganic application and its levels (Table 4.1 and 4.2). Significantly, the highest values of these growth parameters, yield attribute and yield parameters were observed with application of 100 kg RDF ha^{-1} and the lowest values were recorded under 0 kg RDF ha^{-1}. The increase in these components seems to have been brought about by increase in amount of growth and yield attributes substances and naturally occurring phytohormones with an increased inorganic supply to the plant. Probably the increase in auxin supply with higher levels of inorganic brought about increase in the dry matter and enhances the plant growth. This improvement might be due to an early and plentiful availability of inorganic leading to better nutritional environment in the root zone for growth and development. As inorganic is one of the major essential plant nutrients required for growth. Therefore, increased availability of inorganic might have increased cell number and cell size leading to better growth in terms of plant growth. Inorganic is an element of chlorophyll; it harnesses solar energy and fixes atmospheric CO_2 as carbohydrates and amino acids. Thus, inorganic application increased dry matter production. The increased supply of inorganic and their higher uptake by plants might have stimulated the rate of various physiological processes in plant and leads to increased growth parameters, yield attribute and yield. The enhanced growth with inorganic was also reported by Sofi *et al*., (2004) [10], Yadav and Pandey (2005) [12], Chillar and Kumar (2006) [3], Kar *et al*., (2006) [4], Patel *et al*., (2006) [11], Bindhani *et al*., (2007) [2].

Effect of organic Growth parameters, yield attribute and yield of maize viz., plant height, number of cobs per plant, cob length, cob girth, number of grains per cob, 100 grain weight, grain yield, Stover yield, biological yield, net return and BCR were significantly influenced by organic application and its levels (Table 4.1 and 4.2). Significantly the highest values of these growth parameters, yield attribute and yield parameters were observed with application of 10 kg Vc ha^{-1} which the lowest values were recorded under 0 kg Vc ha^{-1}. The improvement in growth parameters with application of 10 kg VC ha^{-1} might have resulted in better and timely availability of fertilizers for their utilization by plant (Table 4.1 and 4.2). Organic fertilization improves the various metabolic and physiological processes and thus known as “energy currency” which is subsequently used for vegetative and reproductive growth through photo-phosphorylation. In addition to vital metabolic role, P is an important structural component of nucleic acid, phytein, phospholipids and enzymes. An adequate supply of organic early in the life cycle of plant is important in laying down the primordial of its reproductive part. It also increases the initiation of both first and second order rootlets and their development. The extensive root system helps in exploiting the maximum nutrients and water from the soil. Under the present investigation, profound influence of P, a component of fertility management, on crop growth seem to be due to maintaining congenial nutritional environment of plant system on account of their greater availability from soil media. The significant improvement in nutrient status of plant parts (stover) might have resulted in greater synthesis of amino acids, proteins and growth promoting substances, which seems to have enhanced the meristematic activity and increased cell division and their elongation. The enhanced growth with organic was also reported by Patel *et al*., (2000) [8], Sahoo and Panda (2001) [9].

On the basis of one year field experimentation, it seems quite logical to conclude that maximum production and net returns from kharif maize by the application of inorganic and organic @ 120 and 60 kg ha^{-1} on calcareous soil under Gwalior agro-climatic Zone.

Conclusion

Based upon this experiment it is concluded that application of optimum level of Inorganic@ 100 kgha with combined application of Organic @ 10 kg/ha recorded the maximum seed yield 42.68q/ha. Application of optimum level of inorganic@ 100 kg/ha with combined application of organic @ 5 kg/ha recorded the maximum and significantly higher net monetary returns (₹56309.3 Rs/ha) and highest B: C ratio was recorded under the same treatment combination with the respective value of 2.64:1. Hence, application of this treatment combination can be adopted in semi-arid zone of gird region of Gwalior district of Madhya Pradesh. However, these results are only indicative and require further experimentation to arrive at more consistent and final conclusion to be passes on the farmers.

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