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INFLUENCE OF DIFFERENT GRANULAR ORGANIC MANURES WITH INORGANIC FERTILIZERS FOR INCREASING THE YIELD OF HYBRID MAIZE (*ZEA MAYS* L.)

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Abstract

Field investigation was conducted at Annamalai University Experimental farm, Annamalainagar to formulate an integrated nutrient management system involving granular form of organic manure granules *viz*., pressmud, seaweed extract granules and Azophos in combination with graded levels of inorganic fertilizers for increasing the yield of hybrid maize during July-November, 2017. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments. All the treatments significantly influenced the crop yield components and yield of hybrid maize. Among the treatments, 75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1} (T_5) resulted in enhanced values of various yield components *viz*., cob length (20.24 cm), cob diameter (7.82 cm) and number of grains cob^{-1} (381.24), grain yield (6718 kg ha^{-1}), stover yield (10197 kg ha^{-1}) and harvest index (39.7). This was closely followed by application of 75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} (T_3) and Recommended Dose of Fertilizer (RDF) alone (250:75:75) kg NPK ha^{-1} (T_1) and they were on par with each other. The treatment 75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1} (T_5) has also recorded the highest net return ha^{-1} and benefit cost ratio. Application of 50 per cent RDF + Azophos @ 4 kg ha^{-1} (T_6) resulted in least values of the yield components of hybrid maize.

Key words : Granular Organic manures, Fertilizers, *Zea mays* L.

Introduction

Maize (*Zea mays* L.) is the third most important crop next to rice and wheat in the world. It is used as both food for human and fodder for animals. Maize has the high production potential compared to any other cereal crop and adaptability to wide range of environments. There is no cereal on the earth which has so immense potentiality and that is why it is called as "Queen of cereals". Apart from being a potential source of food for human beings, it is used for the production of starch, syrup, acetic and lactic acids, paper, rayon, adhesives etc. Maize is therefore an emerging industrial crop. Maize occupies an important place in food production. Maize is a wonder crop, because it can be used at any stage of crop growth. Early stage as succulent green fodder, very early cob stage as baby corn, little later stage as green cob and at fully matured stage as maize grain. Because of this ability it is also called as "Contingent crop". In Worldwide, maize is grown over an area of 185.54 million hectares with a production of 1074.76 million tonnes and with the productivity of 5.79 t ha^{-1}. In India, maize occupies an area of 9.60 million hectares with a production of 26.26 million tonnes and the productivity of 2.74 t ha^{-1} (USDA, 2017). In Tamilnadu, it is cultivated in an area of 0.36 million hectares with production of 2.38 million tonnes and a productivity of 6.5 t ha^{-1} and also it occupies fourth position in Indian maize production (AICRP, 2016). Among the primary maize growing countries of the world India occupies the second lowest position in productivity. Maize being a C_4 plant has higher yield potential which also depends on nutrient supplying capacity of the soil. It is well known that maize is a heavy feeder of nutrients. Maize crop has better yield response to synthetic inorganic fertilizers. Use of inorganic fertilizers for increasing food grain production is inevitable in the present circumstances where food security and livelihood issues of the people have attained national priority. However, indiscriminate prescriptions of inorganic fertilizers alone in long term deleterious to soil health resulting in drastic yield reduction.

Continuous use of inorganic fertilizers leads to deterioration of soil physical, chemical properties and biological activity in soil (Mahajan *et al*., 2008). Many efforts are being exercised to combat the adverse

consequences of chemical farming. Considering these facts, it is important to identify the best type of available organic resources which can be used as a substitute for inorganic fertilizers. Besides NPK supply they make unavailable nutrients and micronutrients into available form. It is also the fact that optimum yield level of maize production cannot be achieved by only using organic manures because of their low nutrient content (Baradhan and Suresh Kumar, 2018). Efficacy of organic sources to meet the nutrient requirement of crop is not as assured as mineral fertilizers. But, the combined use of chemical fertilizers along with various organic sources is capable of improving soil quality and higher crop productivity on long term basis. Therefore, suitable combination of chemical fertilizers and organic manures need to be developed for particular cropping system and soil (Shilpashree *et al*., 2012). As far as organic manures concerned, the main function of them is to provide plant nutrients to the applied soil.

Crop plants remove varying amounts of different nutrients from soil and to compensate the loss from the soil, organic amendments rich in nutrients must be added (Singh and Mandal, 2000). Powdered organic manures are featured with light relative density which is easily blown away by the wind when applying to the crops. After granulation compared with powdered organic manures, granules are compact and dry. Thus they are easily handled and applied to the crops. Granulated organic manures will absorb the moisture slowly and it results in slow release of nutrients thus results in increased nutrient efficiency (Suresh Kumar and Baradhan, 2018). Microbiological fertilizers are important to environment friendly and sustainable agricultural practices (Bloemberg *et al.,* 2000). Biofertilizers are carrier based preparations containing mainly effective strains of microorganisms in sufficient numbers which are useful for nitrogen fixation in plants, solubilization and uptake of phosphorus and synthesis of growth promoting substances like hormones and auxins. A composite biofertilizer inoculum containing both *Azospirillum* and Phosphobacteria is known as Azophos. The main advantage of this single biofertilizer containing both "N" fixer and phosphate solubilizer and it is less expensive, easy to use and also better efficacy of both organisms in mixed culture.

Pressmud is one of the by-products of sugar factory which is also produced to the tune of two per cent of the weight of sugarcane crushed. Pressmud can serve as a good source of organic manure and an alternate source of crop nutrients and soil ameliorates. The utilization of industrial wastes like pressmud on agricultural fields is gaining popularity due to the capacity of the soil is becoming a limiting factor. Pressmud based organic manure granules contains NPK and important micronutrients and has established its importance in improving fertility, productivity and other physical properties of the soils. Seaweeds are the macroscopic marine algae and its use as manure in farming practices is very ancient and prevalent (Thirumaran *et al*., 2009). Marine algal seaweed species are often regarded as an underutilized bio resource, many have been used as a source of food, industrial raw materials, and in therapeutic and botanical applications for centuries. Moreover, seaweeds and seaweed-derived products have been widely used as amendments in crop production system due to the presence of a number of plant growth-stimulating compounds. Seaweed extract is used as a foliar spray, soil application and for soaking the seeds before sowing. It enhances the germination of seeds, increases uptake of plant nutrients, and gives resistance to frost and fungal diseases. Seaweed extract is effective for increasing shelf-life of the produce, improves the quality of produce, and serves as an excellent soil conditioner (Zodape, 2001).

Materials and Methods

Field investigation was conducted at Annamalai University Experimental farm, Annamalainagar during July-November, 2017. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments comprised of T_1 - Recommended dose of fertilizer (RDF) alone (250:75:75) kg NPK ha^{-1}, T_2-75 per cent RDF + Azophos @ 4 kg ha^{-1}, T_3-75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1}, T_4-75 per cent RDF + Azophos @ 4 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1}, T_5-75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1}, T_6-50 per cent RDF + Azophos @ 4 kg ha^{-1}, T_7-50 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1}, T_8-50 per cent RDF + Azophos @ 4 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1}, T_9-50 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1}. All the treatments significantly influenced the crop growth parameters, yield components and yield of hybrid maize. The observation on yield parameters was recorded. The yield attributes which were observed during experiment includes cob length, number of grains per cob, cob diameter and yield. Length of five randomly selected cobs was measured from the base of the butt to last grain of the other end (apex) and the mean length per cob determined in cm. for the cob length. From the five randomly selected cobs the number of grain rows per cob were counted and mean

number of rows per cob calculated and recorded as number of grain rows per cob. The diameter of cobs was measured with the help of Vernier clipper at three places, *i.e.* at the base, the centre and the pointed end of the cob, and the average for individual cob was worked out. Mean diameter from the five mentioned cobs was then calculated and recorded as the diameter of cob. The grain yield of each net plot was thoroughly cleaned and sun dried. The yield from each plot was recorded separately as kg plot $^{-1}$ and then converted in kg ha^{-1}. Statistical analysis was carried out as per the procedure suggested by Panse and Sukhatme (1978).

Results and Discussion

The yield potential of maize is determined by the resultant values of yield components which are greatly influenced by the growth parameters. This is well reflected in the present investigation also. Almost all yield attributing characters *viz.,* number of cobs plant^{-1}, cob length, cob diameter, number of grains cob^{-1} and grain yield of hybrid maize were remarkably influenced by the integration of inorganic fertilizers and organic source of granules. Among the treatments evaluated, 75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1} (T_5) significantly resulted in the highest cob length, number of grains per cob, cob diameter and yield. The application of 75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1} (T_5) resulted in enhanced values of various yield components *viz*., cob length (20.24 cm), cob diameter (7.82 cm) and number of grains cob^{-1} (381.24) and grain yield (6718 kg ha^{-1}). This was closely followed by application of 75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} (T_3) and Recommended Dose of Fertilizer (RDF) alone (250:75:75) kg NPK ha^{-1} (T_1) and they were on par with each other. Application of 50 per cent RDF + Azophos @ 4 kg ha^{-1} (T_6) resulted in least cob length (16.23 cm), number of grains per cob (274.13), cob diameter (4.41 cm) grain yield (3648 kg ha^{-1}).

Almost all yield attributing characters *viz*., cob length, cob diameter, number of grains cob^{-1} and grain yield were remarkably influenced by the practice of integrated nutrient management. Maize yield is a function of different yield components such as cob length, cob diameter and number of grains cob^{-1}. Among the treatments evaluated, application of 75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1} (T_5) significantly resulted in the highest cob length, cob diameter, number of grains cob^{-1} and grain yield. Pressmud is source of macro and micronutrients and growth hormones, which not only supply essential nutrients to the soil but also improve the physio-chemical and biological properties of the soil and slow release of nutrients over longer periods. Pressmud when applied to the soil it changes the form and has best characters *viz*., porosity, ventilation, capacity to maintain humidity in it overfilled with humic material and absorbable elements resulting in beneficial changes in yield and yield components. The constant and optimum release of nutrients from pressmud based organic manure granules and seaweed granules supplemented with NPK fertilizers might have satisfied the nutrition demand of maize at different stages of crop growth. Azophos improves liberation of organic acids by proton extrusion mechanism which stimulates the growth and increases the yield attributes of maize. Addition of Azophos might have prevented the fixation of nutrients in the soil and ensure steady supply of nutrients throughout the growth period that helped in better root and shoot growth. Besides, Azophos improved the organic carbon content of the rhizosphere soil which ultimately increased the nutrient availability results in significant increase of maize yield parameters and yield. The considerable improvement in grain yield owing to application of organic sources of nutrients had the positive effects on yield attributes and cumulative effects of yield attributes mainly responsible for higher productivity with the application of organic sources. The increase in yield attributes *viz*., cob length, cob diameter, number of grains cob^{-1} and grain yield is due to the nutrients supplied are effectively utilized by maize plants which increased the sink capacity which increase the protein content due to increased nutrients uptake by crop. The findings are in line with the findings of Wadile *et al.* (2016). Application of 50 per cent of recommended dose of fertilizers + Azophos @ 4 kg ha^{-1} (T_6) resulted in the least values of yield attributes and yield of maize. This might be due to that 50 per cent of applied fertilizers to the soil remain unavailable to crop due to combination of leaching, fixation and volatilization and also the absence of beneficial effect of pressmud based organic manure granules and seaweed granules. Hence, the lack of availability of adequate amount of essential nutrients which in turn affect development of yield components. These results are in agreement with the findings of Akintoye and Olaniyan (2012).

Conclusion

From the result of the field investigation carried out at Annamalai University Experimental farm, the following conclusion is drawn**.** It may be concluded that application of 75 per cent RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1}

+ Seaweed extract granules @ 20 kg ha^{-1} (T_5) is an eco-friendly and economically suitable nutrient management practice of organic manure granules with graded levels of inorganic fertilizers for enhancing the productivity together with maintenance of soil fertility over a long period of hybrid maize cultivation.

Table 1 : Influence of different granular organic manures with inorganic fertilizers in yield attributes and yield of hybrid maize (*Zea Mays* L.)

Treatments	Cob length (cm)	Cob diameter (cm)	Number of grains cob^{-1}	Grain yield (kg ha^{-1})
T_1 - RDF alone (250:75:75 kg NPK ha^{-1})	19.64	7.30	350.96	5698
T_2 - 75% RDF + Azophos @ 4 kg ha^{-1}	18.34	6.14	319.54	4806
T_3 - 75% RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1}	19.87	7.44	355.71	5874
T_4 - 75% RDF + Azophos @ 4 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1}	19.26	6.70	339.28	5387
T_5 - 75% RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1}	20.24	7.82	381.24	6718
T_6 - 50% RDF + Azophos @ 4 kg ha^{-1}	16.23	4.41	274.13	3648
T_7 - 50% RDF + Azophos @ 4 kg ha^{-1} + Pressmud based organic manure granules @ 150 kg ha^{-1}	18.12	5.92	311.49	4680
T_8 - 50% RDF + Azophos @ 4 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1}	17.98	5.36	298.84	4218
T_9 - 50% RDF + Azophos @ 4 kg ha^{-1}+ Pressmud based organic manure granules @ 150 kg ha^{-1} + Seaweed extract granules @ 20 kg ha^{-1}	19.10	6.50	331.52	5224
S.Ed	0.13	0.15	4.49	117.29
CD (p=0.05)	0.27	0.32	9.51	248.65

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