Effect of Panchagavya and combination of Biofertilizer and RDF on Hybrid maize (Zea mays L.) Production

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ABSTRACT

The experiments were conducted to find out the effect of organic, inorganic and biological sources of nutrients on the growth and yield of hybrid maize. The experiments were laid out at Annamalai University Experimental Farm, Annamalainagar in Randomized Block Design (RBD) with three replications during summer season (March-June) 2014 and 2015. There were altogether twelve treatments *viz*., Control (T_1), Azospirillum seed inoculation (T_2), Panchagavya spray 3% at 30, 45 and 60 DAS (T_3), Recommended Dose of Fertilizers application (T_4), Azospirillum seed inoculation + Panchagavya spray 3% at 30, 45 and 60 DAS (T_5), RDF + Azospirillum seed inoculation (T_6), RDF + Panchagavya spray 3% at 30, 45 and 60 DAS (T_7), Panchagavya spray 3% at before flowering (T_8), RDF+ Panchagavya spray 3% at before flowering (T_9), Azospirillum seed inoculation + Panchagavya spray 3% at before flowring (T_{10}), Azospirillum seed inoculation + RDF+ Panchagavya spray 3% at 30, 45 and 60 DAS (T_{11}) and RDF +Azospirillum seed inoculation+ Panchagavya spray 3% at before flowering (T_{12}). The result of the study clearly showed that, seed inoculation of Azospirillum and application of recommended dose of fertilizers along with foliar spray of panchagavya @ 3% at 30, 45 and 60 DAS (T_{11}) registered higher growth characters, yield components, grain and stover yield. Among the treatments (T_{11}) excelled all other treatments in obtaining higher net return and return per rupee invested in hybrid maize. The result evidently proved that the application Azospirillum and application of recommended dose of fertilizers along with foliar spray of panchagavya @ 3% at 30, 45 and 60 DAS (T_{11}) will be an appropriate integrated nutrient management on the growth and yield of hybrid maize with due care on soil fertility.

Key Words: Maize, Panchagavya, Azospirillum, RDF.

INTRODUCTION

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Globally maize is grown over an area of 168 million hectares with a production of 945.8 million tones. In India, maize occupies an area of 8.67 million hectares with a production of 21.73million tones with a productivity of 2.54 t ha^{-1}. In Tamil Nadu, it is cultivated in an area of 0.22 million hectares with a production of 0.81 million tones and productivity of 4.5 t ha^{-1} and also it occupies fourth position in India maize production. It is a rich source of carbohydrates and has higher percentage of proteins than other cereals. Maize grain contains starch (72%), protein (10%), oil (4.8%), fibre (5.8%), sugar (3.0%) and ash (1.7%).

Maize (*Zea mays* L.) is the third most important cereal crop next to rice and wheat in the World. Maize has been an important economic cereal crop in Indian economy because of its high production potential and it is efficient converter of solar energy into dry matter, compared to any other cereal crop and has adaptability to wide range of environments and higher genetic yield potential, as called as "Queen of cereals" or "Miracle crop". Maize being a C_4 plant has high yield potential. The yield potential of maize could not be utilized fully due to improper and imbalance nutrient management practices. Continuous use of inorganic fertilizers causes several hazards to soil health by heavy withdrawal of nutrients. Nutrient imbalance ultimately result in the technology stresses need for integrated nutrient management which embraces judicial combination of organic manures with inorganic fertilizers for providing better nutrients to the crop plants and maintaining soil fertility.

Integrated Nutrient Management (INM) involving the best combination of available nutrient management technologies would facilitate in achieving the required productivity and sustainability by the efficient use of soil and applied plant nutrients.

MATERIALS AND METHODS

The experiments were conducted in hybrid maize to find out the effect of organic and inorganic nutrient management on growth and yield of hybrid maize during summer season (March-June) 2016 and 2016 at Annanmalai University Experimental Farm, Annamalainagar. The experimental design was laid out in RBD which comprises of three replications and twelve treatments *viz*., Control (T_1), Azospirillum seed inoculation (T_2), Panchagavya spray 3% at 30, 45 and 60 DAS (T_3), Recommended Dose of Fertilizers application (T_4), Azospirillum seed inoculation + Panchagavya spray 3% at 30, 45 and 60 DAS (T_5), RDF + Azospirillum seed inoculation (T_6), RDF + Panchagavya spray 3% at 30, 45 and 60 DAS (T_7), Panchagavya spray 3% at before flowering (T_8), RDF+ Panchagavya spray 3% at before flowering (T_9), Azospirillum seed inoculation + Panchagavya spray 3% at before flowring (T_{10}), Azospirillum seed inoculation + RDF+ Panchagavya spray 3% at 30, 45 and 60 DAS (T_{11}) and RDF +Azospirillum seed inoculation+ Panchagavya spray 3% at before flowering (T_{12}). The soil of the experimental site was clay loam in texture, having pH of 8.1, low in available nitrogen, medium in available phosphorous and high in available potassium. A recommended fertilizer dose of 250:75:75 kg ha^{-1} of N:P_2O_5:K_2O ha^{-1}respectively was followed for hybrid maize. Half dose of N and full dose of P_2O_5 and K_2O were applied as basal. The remaining half dose of N was applied on 25 DAS. Irrigation was given immediately after sowing by avoiding excess flooding of water. Thereafter life irrigation was given on 3 DAS and subsequent irrigation was given at 50% ASM. Irrigation was stopped 10 days prior to harvest. The growth components, yield components and yield were recorded at harvest as per the prescribed standard procedure.

RESULT AND DISCUSSION

Growth characters

The treatments, seed inoculation of Azospirillum and application of recommended dose of fertilizer along with foliar spray of panchagavya @ 3% at 30, 45 and 60 DAS (T_{11}) favourably increased the growth characters *viz*., plant height, leaf area index and dry matter production as compared to other treatments. The treatment T_{11} significantly recorded higher plant height of 95, 242 and 270 cm at 30, 60 DAS and at harvest, respectively. This is due to the presence of naturally occurring beneficial micro organisms in panchagavya. Further better availability of macro nutrients throughout the crop growth period due to application of RDF helped in increasing plant height. The similar findings were reported by Vimalendran and Wahab. (2014). Higher leaf area index of 2.40 and 5.40 at 30 and 60 DAS, respectively were also noticed in the above said treatment. This might be due to the presence of significant quantity of vitamins, natural phytoregulators, macro and micro nutrients, in liquid organic manure in a balanced form might have helped to retard leaf senescence that resulted in large retention of effective photo assimilatory surface and in turn higher leaf area. The same treatment also recorded the highest DMP of 5013, 8590 and 13926 kg ha^{-1} at 30, 60 DAS ad at harvest respectively. This is due to better solar radiation interception and photosynthetic rate, contributing to higher values of varied growth attributes. A similar findings were also reported by Naik *et al*. (2013).

Yield components

The yield attributes *viz*., cob length, cob diameter and number of grains cob^{-1} and test weight were also found to be remarkably increased with Seed inoculation of Azospirillum and application of recommended dose of fertilizers along with foliar spray of panchagavya @ 3% at 30, 45 and 60 DAS (T_{11}) as compared to other treatments by registering maximum cob length of 28.11 cm, cob diameter of 6.07 cm, higher grain number of 393 per cob and highest hundred grain weight of 34.56 g. This is due to the combined application of organic and inorganic may be attributed to the better nutrient availability and its favourably effects on soil physical and biological properties resulting yield attributes and yield. The present results are in line with the finding of Ali *et al*. (2012) and Ravi *et al*. (2012).

Grain and stover yield

The highest grain yield of 6213 kg ha^{-1} and stover yield of 8553 kg ha^{-1} were recorded under Seed inoculation of Azospirillum and application of recommended dose of fertilizers along with foliar spray of panchagavya @ 3% at 30, 45 and 60 DAS (T_{11}). This could be due to enhanced yield components such as cob length, cob diameter, number of grains per cob and test weight which ultimately resulted in higher yield than other treatments. The enhancement in plant growth was due to significant translocation and storage of photosynthates from source to sink, which resulted significantly on enhancement of all the yield attributes and higher grain and stover yield. The present results are in concorunce with the earlier reported by Lone *et al*. (2013).

Economics

Maximum net return of Rs. 56729 ha^{-1}, return per rupee invested of 3.00 were registered with Seed inoculation of Azospirillum and application of recommended dose of fertilizers along with foliar spray of panchagavya @ 3% at 30, 45 and 60 DAS (T_{11}). This could be due to adequate supply of nutrients to crop through inorganic and organic sources favouring better crop growth and yield components and yield ultimately resulted in higher net return and return per rupee invested. The present results are in conformity with the findings of Abbas Ali *et al*. (2016) and Kalhapure *et al*. (2013).

Table 1: Effect of organic and inorganic nutrient management on growth components of hybrid maize at harvest stage (pooled value of 2015 and 2016)

Treatments	Plant height (cm)	Dry matter production (kg ha^{-1})
T_1- Control	170.20	7849
T_2- Azospirillum seed inoculation	190.12	9799
T_3- Panchagavya spray 3% at 30, 45 and 60 DAS	205.40	10680
T_4- Recommended Dose of Fertilizer Application	229.99	11920
T_5- Azospirillum seed inoculation+ Panchagavya spray 3% at 30, 45 and 60 DAS	222.74	11548
T_6- RDF+ Azospirillum seed inoculation	237.25	12290
T_7- RDF+ Panchagavya spray 3% at 30, 45 and 60 DAS	254.05	13120
T_8- Panchagavya spray 3% at before flowering	197.99	10210
T_9- RDF+ Panchagavya spray 3% before flowering	245.62	12716
T_{10}- Azospirillum seed inoculation+ Panchagavya spray 3% at before flowering	214.22	11110
T_{11}- Azospirillum seed inoculation+RDF+ Panchagavya spray 3% at before flowering	269.66	13926
T_{12}- RDF+ Azospirillum seed inoculation+ Panchagavya spray 3% before flowering	262.42	13554
S.Ed	3.68	190.38
CD(p=0.05)	7.37	384.76

Table 2: Effect of organic and inorganic nutrient management on yield components and yield of hybrid maize (pooled value of 2015 and 2016)

Treatments	Number of grains cob^{-1}	100 grain weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1	221	19.08	1821	5620
T_2	255	23.21	3768	6409
T_3	302	25.54	4298	6914
T_4	346	28.76	5059	7551
T_5	341	27.96	4847	7373
T_6	352	29.49	5274	7734
T_7	376	32.89	5763	8159
T_8	279	24.37	4020	6620
T_9	362	31.84	5524	7948
T_{10}	326	26.89	4602	7124
T_{11}	393	34.56	6213	8553
T_{12}	387	33.89	5997	8369
S.Ed	4.07	0.42	109	94.99
CD(p=0.05)	8.45	0.87	227	197.00

Table 3: Economics of hybrid maize (pooled value of 2015 and 2016)

Treatments	Cost of cultivation (Rs.ha^{-1})	Gross return (Rs.ha^{-1})	Net return (Rs.ha^{-1})	Return rupee^{-1} invested
T_1	20320	26482	6162	1.30
T_2	22461	52186	29725	2.32
T_3	23871	59336	35466	2.48
T_4	24920	69544	44624	2.79
T_5	24431	66697	42265	2.72
T_6	25231	72432	47201	2.87
T_7	26720	79000	52470	2.95
T_8	23421	55572	32151	2.37
T_9	25989	75788	49792	2.91
T_{10}	24050	63389	39339	2.63
T_{11}	28231	85050	56729	3.00
T_{12}	27541	82151	54610	2.98

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