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Effect of Phosphorus and Zinc Fertilizers on Growth and Yield of Sorghum

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ABSTRACT

A field experiment was conducted to study the response of sorghum to phosphorus and zinc fertilizers at Agricultural College Farm, Bapatla during *Rabi*, 2020. The experiment was laid out in randomized block design with nine treatments replicated thrice. The results of the experiment indicated that higher drymatter accumalation, yield attributes and yield were recorded with the application of 100% RDP + 75% RD Zn (T_8) which was on par with T_9(125% RDP + 75% RD Zn) and these treatments were significantly superior over the rest of the treatments.

Keywords: *Sorghum,Phosphorus and Zinc.*

Sorghum (*Sorghum bicolor*) is one of the fifth world's most important nutritional cereal crops after wheat, maize, rice and barley and also the major staple food and fodder crop for millions of people in arid and semi-arid tropics. Sorghum, because of its drought resistance and wide range of ecological adaptation is considered as the crop of choice for dry regions and areas with unreliable rainfall. For optimum plant growth, nutrients must be available in sufficient and balanced quantities. Phosphorus (P) is the most limiting nutrient after N for crop yields and is essential for growth and development of sorghum.

Zinc, an active element plays a vital role in biochemical processes has a chemical and biological interaction with some other elements. Most of total soil Zn is in the unavailable form and adsorption is a major contributing factor to a low concentration of Zn in soil solution with low Zn availability. Zinc mobility and uptake in soil is dependent on many factors such as soil acidity, total value of zinc in the soil, organic matter and soil type. Zinc transmission from plant roots to shoots is reduced due to high concentration of phosphorus and zinc uptake was decreased in sorghum with increasing P application up to 60 kg ha $^{-1}$.

P and Zn are both essential nutrients needed for plant growth, but their combined effect at a certain level could be antagonistic especially when the application of soil phosphorus is higher. Higher application of P may cause slower uptake of Zn by the plants (Mengel and Kirkby, 1987) .Due to this there is a need to study the effect of different levels of phosphorus on zinc on their availability and its influence on crop growth and yield.

MATERIAL AND METHODS

A field experimentwas conducted during *Rabi*, 2020 at Agricultural College Farm, Bapatla, Andhra Pradesh. The experiment was designed in RBD consists of nine treatments replicated thrice. The experimental soil was neutral in reaction (pH of 7.10), non-saline (EC 0.51 dS m^{-1}), low in organic carbon (4.30 g kg^{-1}), low in available N (183 kg ha^{-1}), medium in available phosphorus (46.6 kg ha^{-1}), and high in potassium (388 kg ha^{-1}). The treatments details are T_1 - Control (Zero P& Zn), T_2 -100% Recommended Dose of Phosphorus (RDP), T_3 - 100% Recommended Dose of Zinc (RD Zn), T_4 - 75% RDP + 100% RD Zn, T_5-100% RDP + 100% RD Zn, T_6- 125% RDP + 100% RD Zn, T_7- 75% RDP + 75% RD Zn, T_8 - 100% RDP + 75% RD Zn, T_9 -125% RDP + 75% RD Zn. Before sowing10 t $ha^{-1}$of well decomposed farmyard manurewas applied to all treatments. A common dose of nitrogen @ 100 kg ha^{-1} was applied in the form of urea in two equal splits *i.e*., 1/2 as basal and the remaining 1/2 at 60 DAS. Recommended dose of P_2O_5 @ 30 kg ,40 kg and 50 kg ha^{-1} was applied as per the treatments as basal before sowing. A common dose of 60 kg K_2O ha^{-1} was applied as muriate of potash *i.e*., as basal dose. Recommended dose of Zn as $ZnSO_4$ @ 37.5 kg and 50 kg ha^{-1} was applied as per the treatments as basal before sowing.

RESULTS AND DISCUSSION

Dry matter accumulation

The results (Table 1) indicated that progressive increase in drymatter with advancement of crop growth in all the treatments. However, the magnitude of such changes varied with treatments, highest (3256, 5995 and 9318 kg ha^{-1} at vegetative,flowering and harvesting stage)was recorded in treatment T_8(100% RDP +75% RD Zn) and it was on par with 125% RDP + 75% RD Zn (T_9) (3202, 5786 and 9198 kg ha^{-1} at vegetative,flowering and harvesting stage) and these treatments were significantly superior over the other treatments.at harvest, This resulted maximum availability of nutrients as compared to their respective sole application. Further a significant increase in dry matter was observed with increase in phosphorus levels. lower dry matter production (2580, 4680 and 7626 kg ha^{-1} during vegetative, flowering and harvest stage, respectively) was recorded in control treatment [without P & Zn (T_1)]. Crop plants supplied with adequate quantity of phosphorus resulted in greater accumulation of photosynthates which accounted for higher dry matter production. P and Zn application rate convincingly affected total dry matter content, which might be due to the application of more fertilizer to the soil that enhances plant growth, leaf area index and plant height as reported by Jan *et al*., (2013). Prathyusha *et al*., (2020) reported that application of higher phosphorus nutrition significantly increases dry matter accumulation in crop.

Yield attributes

Perusal of the data in the(Table 2) revealed that there was no significant influence of P and Zn fertilizers on panicle length and 1000 grain weight. Whereas panicle width was significantly influenced by the treatments.Whereas highest panicle length ,1000 grain weightand panicle width was recorded with treatment receiving 100% RDP + 75% RD Zn (T_8) (23.20 cm) (30.53g) (14.7 cm). While, lowest (21.30 cm) (24.0 g) (10cm) was observed in control treatment (without P & Zn) (T_1). Among the phosphorus levels, 100 % RDP recorded higher panicle width than other treatments which might be due to increased translocation of photosynthates from source to sink as per the reports of Dar *et al*. (2017). The grain yield is a function of combined influence of the individual yield components nourished under applied inputs and 1000 grain weight is one of the yield attributing factor. At a given dose of P and Zn, a slight increase in the 1000 grain weight was observed. This might be due to the efficient participation of P and Zn in number of metabolic processes involved in production of healthy seed. Similar results were reported by Abid *et al*. (2011). However, Turi*et al*. (2007) reported that difference in panicle length and 1000 grain weight are due to

Table 1. Effect of phosphorus and zinc fertilizers on dry matter production (kg ha^{-1}) at different growth stages of sorghum.

Treatment	Dry matter Production (kg ha^{-1})		
	vegetative	flowering	Harvest
T_1 : Control (Zero P & Zn)	2580	4680	7626
T_2 : 100% RDP	2685	4982	7882
T_3 : 100% RD Zn	2608	4802	7764
T_4: 75 % RDP + 100% RD Zn	2856	5250	8278
T_5 : 100% RDP + 100% RD Zn	2778	5118	8418
T_6 : 125% RDP + 100%RD Zn	2814	5210	8155
T_7 : 75% RDP + 75% RD Zn	2710	5015	8382
T_8 : 100% RDP + 75% RD Zn	3256	5995	9318
T_9 : 125% RDP + 75% RD Zn	3202	5786	9198
S.Em (±)	117.1	226.9	291
CD (P = 0.05%)	354.2	686.6	881
C.V (%)	7.16	7.55	6.05

Table 2. Effect of phosphorus biofertilizers on yield and yield attributing characters of sorghum

Treatment	Panicle length (cm)	Panicle width (cm)	Test weight (g)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
T1 : Control (Zero P & Zn)	21.30	10.00	24.00	23.00	48.90
T2 : 100% RDP	21.90	11.00	24.90	28.10	52.20
T3 : 100% RD Zn	21.80	10.50	24.30	25.50	50.50
T4 : 75 % RDP + 100% RD Zn	22.30	12.00	27.00	32.75	62.70
T5 : 100% RDP + 100% RD Zn	22.20	13.00	26.00	30.30	58.80
T6 : 125% RDP + 100%RD Zn	22.70	11.50	26.50	32.00	60.30
T7 : 75% RDP + 75% RD Zn	22.00	12.80	25.70	28.90	55.20
T8 : 100% RDP + 75% RD Zn	23.20	14.70	30.53	36.80	70.40
T9 : 125% RDP + 75% RD Zn	23.00	13.80	28.23	35.13	69.40
S.Em (±)	0.87	0.54	2.10	1.30	2.52
CD (P = 0.05%)	NS	1.62	NS	3.94	7.63
C.V (%)	6.75	7.63	13.79	7.42	7.33

genetic characters which would not be affected by the environment and inputs.

Grain yield and Stover yield

The data pertaining to number of grain and stover yield recorded highest with the application of 100% RDP + 75% RD Zn (T_8) (36.80 q ha^{-1}) &(70.40 q ha^{-1}) followed by T_9-125% RDP + 75% RD Zn (T_9) (35.13 q ha^{-1})& (69.40 q ha^{-1}) which were statistically on par and markedly superior over other treatments. Whereas, lowest grain and stover yield (23.00 q ha^{-1}) &(48.90 q ha^{-1}) were observed in control treatment (without P & Zn) (T_1). Application of P and Zn recorded significantly higher straw yield due to better performance of growth and yield parameters through adequate availability of major and micronutrients in soil, which in turn, favourably influenced physiological processes and build-up of photosynthates. These results were in conformity with those of Tabassum *et al*. (2013). Both P and Zn are important for obtaining good yields although they are antagonistic in nature to each other. Optimum levels of Zn and P were required for improving individual plant performance that might be the possible reasons for higher grain yield. Both Zn and P also responsible for activating some enzymatic processes *i.e.*, carbonic anhydrase, dehydrogenase, proteinase and peptidase including their role as catalyst in various growth processes, hormone production and protein synthesis, Crop plants supplied with adequate quantity of phosphorus resulted in greater accumulation of photosynthates which ultimately promoted growth of the plant resulting higher grain yield. Earlier studies (Sharma *et al*., (1994), Sarangi and Sharma (2004) and Ramana *et al*., 2006) al so reported similar results. application of more amount of phosphorus fertilizer from 0 up to 60 kg P_2O_5 ha^{-1} significantly increased grain and stover yield of sorghum (Gahukar*et al*. 2011).

CONCLUSIONS

It can be concluded that the application of phosphorus and zinc fertilizers significantly influenced dry matter accumulation, panicle width,grain and stover yield. Addition of 100% RDP along with 75%RD Znsignificantly increases the yield and yield attributes of sorghum.

LITERATURE CITED

Abid M, Ahmad N, Jahangir M and Ahmad I 2011 Effect of zinc, iron and manganese on growth and yield of rice (Oryza sativa L.). *Pakistan Journal of Agricultural Sciences*, 39(3):19-27.

Dar M H, Bhat A H and Shahid S 2017 Combined application of phosphorus and biofertilizers yield of maize under inter cropping system in temperate region of Kashmir valley. *International Journal of Advance Research in Science and Engineering*. 2(1):772-778.

Gahukar T S, Veeraraghavaiah R, Pulla Rao Ch and Lakshmi, G V 2011 Effect of Agro-techniques on Yield, Yield Attributes and Phosphorus Uptake of Maize (*Zea mays* L.) in Mining Soil Reserve Phosphorus. *The Andhra Agricultural Journal*. 58(3): 279-282.

Jan A, M Wasim and Jr Amanullah 2013 Interactive effects of zinc and nitrogen application on wheat growth and grain yield. *Journal of Plant Nutrition*, 36: 1506-1520.

Mengel K and Kirkby E A 1987 Principles of Plant Nutrition. A-BernSwitzerland: International Potash Institute; pp. 452-453.

Prathyusha T Lalitha Kumari A Venkata Subbaiah P and Martin Luther M 2020 Effect of Phosphorus Biofertilizers along with Inorganic Fertilizers on

Growth and Yield of Maize *The Andhra Agricultural Journal*. 67 (4): 325-328.

Ramana A V, Reddy D S and Reddy K R 2006 Influence of mulching and micronutrient management practices on upland rice. *Karnataka Journal of Agricultural Sciences*, *19*(4), p.785.

Sarangi S K and Sharma H C 2004 Influence of mode of iron application and growth-regulators on development, yield attributes and yield of upland rice (Oryza saliva). *Indian journal of agricultural science*, *74*(12), pp.637-642.

Sharma K N, Singh H and Vig A C, 1994 Influence of continuous cropping and fertilization on adsorption and desorption of soil phosphorus. *Fertilizer research*, *40*(2), pp.121-128.

Tabassum S, Khamparia R S and Singh S 2013 Effect of zinc and organic manures on yield attributes and yield of rice. Bioinfolet. 10(3A): 879-881.

Turi N A, Shah S S, Ali S, Rahman H, Ali T and Sajjad M 2007 Genetic variability for yield parameters in maize (Zea mays L.) genotypes. *Journal of Agriculture and Biological Sciences*, *2*(4-5), pp.1-3.

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