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Effect of Different Sources and Levels of Potassium on Growth and Yield of Hybrid Maize (*Zea mays* L.) under Low K soils of Eastern Dry Zone of Karnataka

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ABSTRACT

A field study was conducted to evaluate the different forms and levels of potassium on growth and yield of hybrid maize crop in low K soils at farmer's field in Eastern dry zone of Karnataka. The results revealed that among the different sources (forms) of potassium fertilizers, potassium schoenite (S_2) increased the growth and yield parameters of maize crop and among the levels of potassium 125 per cent of RDK (L_4) has recorded higher growth and yield parameters. Similarly, higher grain yield (77.45 qt ha^{-1}) and stover yield (116.38 qt ha^{-1}) was recorded in treatment (S_2L_4) which received 125 per cent of RDK through potassium schoenite compared to that of MOP and Bio-K.

MAIZE (*Zea mays L.*) is one of the most versatile emerging crop having wider adoptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because of its highest genetic yield potential among the cereals. In India, maize is the third most important food crops after rice and wheat. According to an estimate it is cultivated in an area of 9.43 m ha (2013-14), which accounts for 6.6 percent of cultivable area and contributes nearly 9 percent in the national food basket.

Potassium is one of the constituents of soil and plant. Potassium affects the turgor pressure and adjusts the opening and closing of stomata, accumulation and transfer of carbohydrates and helps to maintain water balance in plant (Tabatabai, 2010). Maize plant has the ability to absorb the available potassium in the soil to an amount of about 80% of their dry weight. Thus, for providing the required amount of potassium for the plant, application of potassium fertilizer is recommended.

On the other hand, India largely depends upon import of potassic fertilizers at the expense of heavy foreign exchange. The country has imported 31.80 lakh million tonnes of potassium fertilizer during 2013-14. So, there is a need to see for locally available alternate K fertilizers in India, so that foreign exchange can be reduced to that extent. In this context to evaluate performance of indigenously developed different forms of pottasic fertilizers in comparison with MOP, two field experiments were carried out in Saslu (Site-1) and Sothenahalli (Site-2) villages in Dodaballapur taluk, Bangalore rural district during *kharif* 2014-15 and *kharif* 2015-16 with maize as a test crop. The physico-chemical properties of soils are given in Table I. The soils were of sandy loam and sandy clay loam textures in site 1 and 2, respectively. The pH was acidic in reaction, available N was medium, available P was high in site 1, whereas it was low in site 2 and available K was low in both the sites.

The experiment was laid out in factorial randomized complete block design with 13 treatments comprising of MOP, Potassium schoenite and Bio-K as three sources of K and 50 per cent, 75 per cent, 100 and 125 per cent of RDK as four levels of K with one control. The recommended dose of N, P, FYM and $ZnSO_4$ were applied for all the plots with different levels of potassium as per the treatments. Five plant observations on growth parameters like plant height and number of leaves were recorded at tasseling stage, and yield parameters like cob length, number of rows in cob, number of seeds per row, number of seeds per cob, grain and stover yield per hectare were recorded at harvest.

Growth parameters of maize as influenced by different sources (forms) and levels of K are shown in Fig. 1. There was no significant difference among the different forms of K with respect to plant height and number of leaves. Among the levels of K applied,

TABLE I

Initial physico-chemical properties of soils in the study area

Soil parameters	Site 1	Site 1
Sand (%)	74.4	68.8
Silt (%)	7.6	9.4
Clay (%)	18.0	21.8
Soil Texture	Sandy loam	Sandy clay loam
B.D (g cc^{-1})	1.59	1.52
pH (1:2.5)	5.26	5.04
EC (dS m^{-1})	0.161	0.054
OC (%)	0.46	0.38
Available N (kgha^{-1})	298.54	312.35
Available P_2O_5 (kgha^{-1})	71.01	10.14
Available K_2O (kgha^{-1})	93.60	112.80
Exchangeable calcium (c mol (P^+) kg^{-1})	1.75	3.75
Exchangeable magnesium (c mol (P^+) kg^{-1})	0.75	1.50
Available Sulphur (mg kg^{-1})	11.02	8.24
DTPA-Iron (mg kg^{-1})	14.71	16.37
DTPA-Manganese (mg kg^{-1})	8.74	7.68
DTPA-Zinc (mg kg^{-1})	1.38	1.27
DTPA-Copper (mg kg^{-1})	0.79	0.83

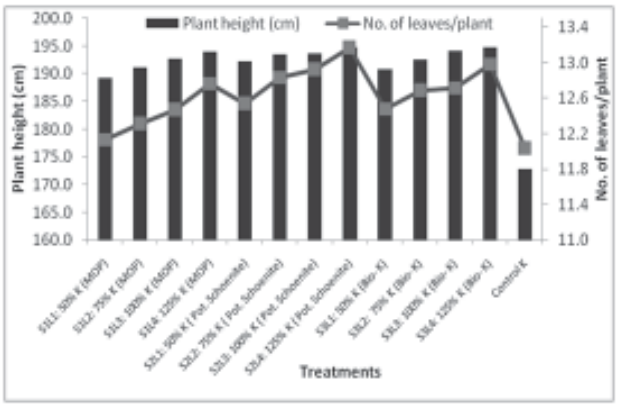

Fig. 1 : Growth parameters of maize as influenced by different forms and levels of potassium

the treatment (L_4) which received 125 per cent RDK recorded greater plant height (194.52 cm) and number of leaves (12.97) per plant. However, number of leaves per plant was statistically on par with 75 and 100% RDK. This might be due to increased levels of K which has increased the rate of photosynthesis. These results are in conformity with the findings of Hatti and Pond (1970) and Ali *et al*. (1978). The interactions between the forms and levels of K showed significant difference in growth parameters, where higher plant height (194.77 cm) and number of leaves (13.16) were recorded in S_2L_4, which was on par with S_3L_4.

Yield parameters of maize as influenced by different sources and levels of K are depicted in Table II. There was no significant difference observed in cob length and number of rows per cob among the different sources of K fertilizers irrespective of the levels of K applied. However, numerically higher values were recorded in potassium schoenite (S_2) applied plot. Similarly, significantly higher number of seeds per row, number of seeds per cob and test weight (32.73, 527.23 and 31.07 gm, respectively) were recorded in potassium schoenite applied (S_2) plot over MOP (S_1) (30.45, 473.17, 28.55, respectively) irrespective of levels of K applied and it was statistically on par with the Bio-K (S_3). Both these K fertilizers contain sulphur which might have helped in higher assimilation by increasing uptake of N (Srivastava and Singh, 2007).

Among the levels of K applied, significantly higher cob length, number of seeds per row and number of seeds per cob (18.35, 35.19 and 576.95, respectively) were observed where 125 per cent RDK (L_4) was applied irrespective of sources, as these soils are low in available potassium content, extra application of 25% K over the 100 per cent RDK (L3) resulted in good response of yield parameters. Similarly, test weight of maize seeds was higher (32.52 gm) at 125 per cent of RDK (L_4) application and was statistically on par with 100 per cent of RDK (L_3). This might be due to decreased number of shriveled seeds, as the levels of K increased.

Among the interactions significantly higher cob length (18.80 cm) was observed in treatment receiving 125 per cent RDK (S_2L_4) through potassium schoenite which was statistically on par with S_1L_4, S_2L_3, S_3L_3 and S_3L_4 (17.82, 17.32, 17.28, 18.43 cm, respectively).

TABLE II

Effect of different forms and levels of K fertilizer on yield parameters of hybrid maize

Treatments	Cob length (cm)	No. of cows cob^{-1}	No. of seeds cow^{-1}	No. of seeds cob^{-1}	Test wt. (gm)
S_1: MOP	16.35	15.46	30.45	473.17	28.55
S_2: Pot. Schoenite	17.07	16.09	32.73	527.23	31.07
S_3: Bio-K	16.75	15.86	32.20	513.23	30.45
SEm±	0.30	0.26	0.80	16.39	0.78
CD @5%	0.85	0.73	2.27	46.32	2.20
L_1: 50 % K	15.31	15.14	28.82	437.20	27.05
L_2: 75 % K	16.19	15.69	31.02	487.88	29.56
L_3: 100 % K	17.05	15.99	32.14	516.15	30.98
L_4: 125 % K	18.35	16.38	35.19	576.95	32.52
SEm±	0.35	0.30	0.93	18.93	0.90
CD @5%	0.99	0.85	2.62	53.49	2.54
S_1L_1: 50% K (MOP)	15.06	14.80	28.10	416.69	26.18
S_1L_2: 75% K (MOP)	15.98	15.27	28.98	443.14	27.69
S_1L_3: 100% K (MOP)	16.53	15.65	30.23	476.05	29.29
S_1L_4: 125% K (MOP)	17.82	16.11	34.50	556.81	31.06
S_2L_1: 50% K (Pot. Schoenite)	15.72	15.40	29.77	457.77	28.19
S_2L_2: 75% K (Pot. Schoenite)	16.45	15.90	32.60	516.82	30.58
S_2L_3: 100% K (Pot. Schoenite)	17.32	16.37	33.30	545.51	32.09
S_2L_4: 125% K (Pot. Schoenite)	18.80	16.70	35.23	588.81	33.40
S_3L_1: 50% K (Bio- K)	15.15	15.23	28.60	437.15	26.77
S_3L_2: 75% K (Bio- K)	16.15	15.90	31.47	503.67	30.40
S_3L_3: 100% K (Bio- K)	17.28	15.97	32.90	526.87	31.56
S_3L_4: 125% K (Bio- K)	18.43	16.33	35.83	585.23	33.09
Control K	12.53	14.27	24.77	357.88	24.89
SEm±	0.60	0.52	1.61	32.78	1.56
CD @5%	1.71	1.46	4.55	92.65	4.40

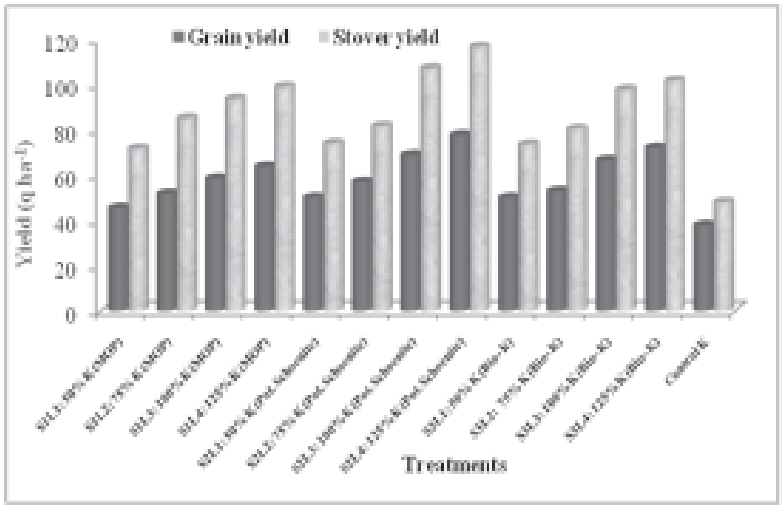

Fig. 2 : Effect of different forms and levels of potassic fertilizers on grain and stover yield of maize

Similar trend was observed with respect to number of rows per cob in treatment receiving 125% RDK (S_2L_4) through potassium schoenite. However, significantly higher number of seeds per row was observed in treatment receiving 125 per cent of RDK (S_3L_4) through Bio-K (35.83), which was statistically on par with S_1L_4, S_2L_2, S_2L_3, S_2L_4, S_3L_2 and S_3L_3 (34.50, 32.60, 33.30, 35.23, 28.60, 32.90 respectively). Similarly, significantly higher number of seeds per cob (588.81) was recorded in treatment which received 125 per cent RDK through potassium schoenite (S_3L_4) followed by 125% RDK through Bio-K. This increased number of seeds per cob was mainly due to higher cob length, number of rows per cob and number of seeds per row, in these treatments. In addition, potassium schoenite and Bio-K contain S and Mg which might have increased assimilation rate.

Grain and stover yield of maize as affected by different forms and levels of K fertilizers is depicted in Fig 2. Among the sources of K tried, potassium schoenite (S_2) has given higher grain (63.29 qt ha^{-1}) and stover (94.76 qt ha^{-1}) yield irrespective of levels of K applied. Similarly, there was an increase in grain and stover yield with increase in levels of K applied. The highest grain (70.99 qt ha^{-1}) and stover (105.58 qt ha^{-1}) yield was observed at 125 per cent of RDK (L_4). Similarly, among the interactions of sources and levels of K, higher grain and stover yield (77.45 and 116.38 q ha^{-1}, respectively) was recorded in treatment which received 125 per cent RDK through potassium schoenite (S_2L_4). This increased yield of maize was mainly due to increased cob length, number of seeds per row, number of seeds per cob and test weight in these treatments (S_1L_4, S_2L_4 and S_3L_4). Better response to extra addition of K fertilizer was observed over the RDK due to presence of very low level of available potassium in these soils. In addition, potassium schoenite and Bio-K have supplied S and Mg which might have resulted in better assimilation by increasing uptake of N. Mg, is found as the central component of the chlorophyll molecule and thus, it is intimately involved with photosynthesis in plants.

From this study, it was concluded that application of additional level of K over RDF is beneficial in getting higher yield of hybrid maize in Eastern dry zone of Karnataka. Similarly, among the sources of K fertilizers, potassium schoenite has given higher yield of maize at 125% RDK when compared to that of MOP and Bio-K.

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