DOI: 10.15740/HAS/AU/12.TECHSEAR(4)2017/1063-1066 *Agriculture Update*
Volume **12** | TECHSEAR-4 | 2017 | 1063-1066
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RESEARCH ARTICLE :

Production potential of maize as influenced by crop residue incorporation and nitrogen levels in legume-cereal sequence

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ARTICLE CHRONICLE :
Received :
14.07.2017;
Accepted :
29.07.2017

SUMMARY : Field experiments were conducted during 2011-12 and 2012-13 at Agricultural College, Aswaraopet with an objective to find the influence of *Kharif* legume, residue management practices and nitrogen levels on the performance of succeeding maize. The treatments consists of three legume crops, *viz.*, cowpea, fieldbean and greengram as *Kharif* legume crops, two residue management practices *viz.*, residue removal (I_0), Residue incorporation (I_1) as sub plotsand four nitrogen levels (75,150,225 and 300 kg ha^{-1}) as sub-sub plot plots allocated to maize. The growth, yield and yield attributing characters like drymatter accumulation, kernel rows per cob, number of kernels per cob and yield were significantly influenced by *Kharif* legume crops, residue management practices and nitrogen levels. The highest drymatter accumulation of maize was observed when cow pea was taken as a preceding crop to maize followed by field bean and greengram. Incorporation of residues of previous legumes was found to increase the yield of succeeding maize byseven per cent over the residue removal. Application of nitrogen @ 300 kg ha^{-1} was found significantly superior to 75 and 150 kg N ha^{-1} and comparable with 225 kg N ha^{-1}. Incorporation of previous crop residues in conjunction with 300 kg N ha^{-1} may be adopted to enhance the productivity of maize in legume – maize sequence.

KEY WORDS :
Crop residue, Legume- maize sequence, Nitrogen levels

How to cite this article : Ammaji, P. and Rao, Ch. Pulla (2017). Production potential of maize as influenced by crop residue incorporation and nitrogen levels in legume- cereal sequence. *Agric. Update,* **12** (TECHSEAR-4): 1063-1066; **DOI: 10.15740/HAS/AU/12.TECHSEAR (4)2017/1063-1066.**

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BACKGROUND AND OBJECTIVES

Maize (*Zea mays* L.), is one of the important cereal crops grown in the world after wheat and rice. The importance of maize lies in its wide industrial uses besides serving as food and fodder. It is the most versatile crop with wider adaptability to varied agro ecological regions and zones. Since the demand for the maize is increasing globallydue to its multiple uses there is a need to enhance its productivityfrom same or even less available resources. The full yield potential of maize crop can be exploited through adoption of hybrids with better nitrogen management practices. Over dependence on chemical fertilizers alone would lead to gradual decline in organic matter content and native fertility status of the soil, which in turn, reflects on

productivity of maize crop On the other hand organic manures need to be applied in bulk to meet the heavy nutrient requirement of maize crop. Hence, a strategy of integrated use of nitrogen through fertilizer in combination with any amount of cheaper organic source which is abundantly available should be tried to satisfy the higher nitrogen requirement of the crop to produce higher yield without impairing the soil health. Although, fertilizer practices plays a dominant role in increasing the production, crop residues still play an essential role in recycling and meeting the nutrient demand of the succeeding crop (Singh *et al*., 2005). Thus, the present work was under taken to determine the effect of legume crop residue incorporation in conjunction with nitrogen levels on the productivity of maize.

RESOURCES AND METHODS

Field experiments were conducted during *Kharif* and *Rabi* seasons of 2011-12 and 2012-13 at Agricultural college, Aswaraopet, Khammam (dist.), Telangana state. Soils of the experimental site was sandy clay in texture, slightly alkaline in reaction (pH 7.8), low in available nitrogen, (148 kg ha^{-1}), medium in available phosphorus (33 kg ha^{-1}) and high in available potassium (256 kg ha^{-1}). The experiment was laid out in split- split plot design and the treatments were replicated thrice. The three legume crops, *viz.*, cowpea, (M_1) fieldbean (M_2) and greengram (M_3) as main plot treatments taken up during the *Kharif* season and two residue management practices *viz.*, residue removal (I_0) and residue incorporation (I_1) were taken as sub- plot treatments. Four nitrogen levels 75 kg ha^{-1} (N_1), 150 kg ha^{-1} (N_2), 225 kg ha^{-1} (N_3) and 300 kg ha^{-1} (N_4) as sub- sub plot treatments to maize were applied during *Rabi*

During two years of study Co-4, HA-3, MGG-295 varieties of cowpea, field bean and greengram, respectively, were raised as *Kharif* legumes while 30-V-92 a popular maize hybrid was grown during *Rabi*. In half of the plot residues are removed while in the another half of the plot residues are incorporated after harvesting the economic yield. The residue was allowed to decompose in the field for one month. Thereafter, field was thoroughly preparedto sow the succeeding maize. The maize crop was sown by adopting a spacing of 60 x 20 cm for the two consecutive years. Nitrogen was applied in the form of urea as per the treatments in three splits *viz.*, ¼ th at the time of sowing, ½ at knee-high stage and the remaining ¼ at tasselling stage. A common dose of 60 kg P_2O_5 and 50 kg K_2O was applied in the form of single super phosphate and muriate of potash at the time of sowing. The data was collected on growth parameters and yield attributes and yield. The data recorded for different parameters was analysed through analysis of variance (ANOVA) technique for split split plot design using Indostat software.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Drymatter production :

Drymatter production was significantly influenced by the *Kharif* legume crops. Cowpea as a preceding legume to maize has accumulated maximum amount of dry matter which was significantly superior to greengram and remained at par with field bean during both the years of investigation (Table 1). While, incorporation of crop residue, significantly influenced the dry matter accumulation over the removal during the first year of study only. Whereas, residue addition or removal does not show significant influence on dry matter accumulation in the second year. Nitrogen application had a significant influence on accumulation of drymatter upto the highest level tried during 2011-12.The superiority of cowpea-maize sequence compared to other sequences might be due to the improvement in soil N status subsequent to the legumes due to the biological nitrogen fixation of the legumes. These results are in accordance with the findings of Tanimu *et al.* (2007) and Sharma and Behera (2009).

Number of Kernel rows per cob :

The kernel rows per cob were significantly affected by all the three factors under study. However, the interactions were found to be non- significant. The highest number of kernel rows per cob obtained with cowpea were 15.7 and 16.1 during first and second year, respectively. While, it was at par with field bean in the first year and significantly superior to other two legumes during the second year. Incorporation of residue significantly increased the number of kernel rows per cob compared to their removal during both the years. Application of N at 300 kg ha^{-1} resulted in significantly

more number of kernel rows per cob over the lower levels in 2011-12. While 225 and 300 kg N ha^{-1} are comparable during 2012-13 (Table 1). These results are in accordance with the findings Rao (2012).

Number of Kernels per cob :

The highest kernel number of 320 and 325 per cob was recorded during first and second year, respectively, with cowpea as a preceding crop to maize and was significantly superior to other two legume crops. The residue incorporation or non incorporation has no significant effect on kernel number per cob during both the years. The number of kernels per cob increased significantly with increase in level of N application. The highest number of kernels per cob (370 and 371) was recorded with the application of 300 kg N ha^{-1}. However, the influence of N application @ 225 and 300 kg ha^{-1} during both the years of investigation could not influence the number of kernels per cob significantly.

Kernel yield:

Among different *Kharif* legume crops tested, cowpea preceded to maize resulted in significantly highest kernel yield of 6092 kg ha^{-1} and 6317 kg ha^{-1} during first and second year of study, respectively. While the difference between field bean and greengram as preceding crops to maize were comparable during both the years. Residue incorporation has resulted in significant increase in kernel yield of succeeding maize during both the years. The per cent increase in kernel yield of maize due to residue incorporation is six and seven per cent during first and second years, respectively. Increase in the level of nitrogen has significantly increased the kernel yield of maize. Application of 225 and 300 kg N ha^{-1} increased the grain yield by 48.3 and 54.7 per cent, respectively over 75 kg N ha^{-1}. Further, grain yield produced with 225 and 300 kg N ha^{-1} was not significant during 2011-12. Similarly, during second year, compared to 75 kg N ha^{-1}, application of 225 and 300 kg N ha^{-1}

Table 1: Dry matter production yield and yield attributes of maize as influenced by *Kharif* legumes, residue management practices and nitrogen levels

Treatments	Dry matter production (g)	No. of rows per cob	No. of kernels per cob	Yield (qha^{-1})	Dry matter production (g)	No. of rows per cob	No. of kernels per cob	Yield (qha^{-1})
	2011-12				2012-13			
Legume crops								
Cowpea	10854	15.70	320	6072	11000	16.16	325	6316
Field bean	10370	15.00	307	5646	10636	15.41	313	5864
Greengram	10084	14.45	300	5417	10536	14.87	302	5683
S.E.±	131	0.19	2.20	116	112	0.11	2.68	93.2
C.D. (P=0.05)	516	0.75	6.67	458	441	0.44	10.52	366
CV (%)	7	8.3	19.5	18.4	11.8	8.8	18	20.8
Residue management practices								
Residue removal	10072	14.61	304	5532	10372	15.00	309	5742
Residue incorporation	10800	15.50	314	5884	11116	15.97	318	6167
S.E.±	78	0.07	3.78	95	133	0.06	1.38	100.6
C.D. (P=0.05)	272	0.26	NS	329	432	0.21	NS	348
CV (%)	10	8.8		20.8	9.2	8.8		20.2
Nitrogen levels (kg ha^{-1})								
75	9446	13.33	229	4379	9696	13.66	234	4565
150	10215	14.72	277	5257	10517	15.22	284	5571
225	10813	15.83	361	6435	11133	16.38	364	6608
300	11270	16.33	370	6762	11631	16.66	371	7073
S.E.±	150	0.14	5.00	186.4	221	0.09	2.96	195.3
C.D. (P=0.05)	432	0.40	14.36	534.7	636	0.27	8.50	560.1
CV (%)	6	5.7	9.0	15.3	7	5.6	6.3	14.1

NS= Non-significant

increased the grain yield by 18 and 27 per cent, respectively.

Improvement in the kernel yield of maize when preceded by legumes may be attributed to contribution of N besides other potential benefits like supply of other nutrients like Potassium, Calcium and Magnesium. Similar results were also reported by Bhal and Pasricha (2000); Yusuf *et al*. (2009) and Arif *et al*. (2011). In residue management treatments,decomposition and mineralization of residues might have coincided with the early growth stages of succeeding maize which might have contributed for the better performance of the maize over no residue incorporation. The present findings are in corroboration with the results reported by Tiwari *et al*. (2004).

Improvement in kernel yield of maize with every successive increase in level of nitrogen might be due to the manifestation of elevated level of growth and yield structure resulting in the superior performance of maize over the lower levels. The beneficial role of nitrogen in enhancing the yield components and inturn the yield was very well established by a number of workers like Sharma and Behera (2009) and Yusuf *et al.* (2009).

Incorporation of legume crop residues after harvesting the economic yield in conjunction with application was found to be beneficial in increasing the grain yield of succeeding maize.

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