Original Research Article

Effect of Nutrient Management and Crop Residue Incorporation on Phosphorus Uptake of Maize (*Zea mays* L) at different growth stages

ABSTRACT

The uptake of phosphorus was found to increase with each successive increase in nitrogen level from 200 to 300 kg ha^{-1} and up to 60 kg ha^{-1} with increase in age of the crop with higher uptake at 300 kg N ha^{-1} and 60 kg P_2O_5 ha^{-1}. Crop sown in N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded significantly higher phosphorus uptake by grain. Higher nutrient uptake was recorded in F_2 (125% of F_1) and F_4 (F_2+ Kharif crop residue incorporation), while the sub plot F_1 (Recommended dose of N and P_2O_5) and F_3 (F_1+ Kharif crop residue incorporation) recorded lower nutrient uptake during both the years.

Keywords: Phosphorus uptake, Crop resides, Crop yield.

1. INTRODUCTION

Crop residues are the parts of crops left over after the usable portions have been removed. Crop residues incorporated into the soil can serve as a source of nutrient recycling for plant growth and maintenance of soil fertility (Cooperband, 2002). The estimated annual production of crop residues in India is 501 million tonnes, containing 8.02 million tonnes of NPK (MNRE, 2009). Jain (1993) reported that in India, large quantities of crop residues are made available every year and about one third of the residues produced are available for direct recycling on the land and if used can add 2.19 million tonnes of NPK annually.

To meet the growing demand, enhancement of maize yield in coming years across all the growing locations in a sustainable way in India is the big challenge. Maize is a heavy feeder of nutrients, especially nitrogen and phosphorus, the deficiency of which limits the growth, yield and quality of the crop. In order to meet such challenges, 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 the future productivity. In addition, due to recent escalation inprices of nitrogenous and phosphatic fertilizers, maize growers are facing crisis in purchase of the above fertilizers. On the other hand, organic manures need to be applied in bulk to meet the heavy nutrient requirement of hybrid maize for improving the fertility status of the soil on sustained manner, which is also not possible due to the scarcity of organic manures. Hence, a strategy of integrated use of nitrogen and phosphorus fertilizers in combination with any amount of cheaper organic source like previous crop residue, which is abundantly available locally should be tried to satisfy the crop requirement to produce higher yield, without impairing soil health. The application of organic residue (e.g., straw) to soils represents a valuable recycling strategy (Cayuela *et al*., 2009), which reduces in part our dependence on mineral fertilizers.

Maize crop residues are usually burnt in the field or widely used as animal feed or used as fuel for cooking against the ample benefits obtained through their incorporation, which would actually improve the fertility status of the soil for producing higher crop yield. Being the originator of crop residues, land has the first right to seek return of the nutrients removed by the crop from it for maintaining its sustainability. It is also closest to the site of residue production, thus saving on handling and transport costs. The rate ofdecomposition of maize crop residue is also not a problem in the soils with luxuriant microbial population including termites. Hence, it is essential to estimate the quantity of nutrient uptake by the maize crop to get the benefits of residue incorporation.

2. MATERIAL AND METHODS

The field experiment was conducted at College Farm of Agricultural College, Mahanandi campus of Acharya N. G. Ranga Agricultural University, situated at 15.51°N latitude, 78.61°E longitude and at an altitude of 233.5 m above the mean sea level, in the scarce rainfall zone of Andhra Pradesh. A composite soil sample was collected at random from 0-30 cm soil depth and analyzed for physico-chemical properties prior to start of the experiments. The soil was sandy loam in texture, neutral in reaction, low in organic carbon and available nitrogen, high in available phosphorus and potassium. The experiment was conducted in the same plots of *kharif* season and was laid out in a split-plot design with three replications.

2.1 Treatments

There were nine main plots consisting of three nitrogen levels and three phosphorus levels of *kharif* season and four sub plots comprising of fertilizer and crop residue management practices.

2.1.1 Main plot treatments

Nine main plots (residual nutrients) consisting combination of three nitrogen levels 200, 250 and 300 kg N ha^{-1} (N_1, N_2 and N_3 respectively) and three phosphorus levels 40, 60 and 80 kg P_2O_5 ha^{-1} (P_1, P_2 and P_3 respectively) of *kharif* season.

2.1.2 Sub plot treatments

Four sub plots (nutrient doses ± crop residues) comprising of fertilizer and crop residue management practices. F_1 : Recommended dose of N and P_2O_5 (250 kg N and 80 kg P_2O_5 ha^{-1}),F_2 : 125% of F_1, F_3 : F_1+ *Kharif* crop residue incorporation and F_4 : F_2+ *Kharif* crop residue incorporation. A common dose of 60 kg K_2O ha^{-1} was applied to all the plots.

The crop was sown at a spacing of 75 cm × 15 cm. The test cultivar was P-3396 a single cross hybrid with the yield potential ranging from 7.5 to 8.0 t ha^{-1}. After harvest of the economic produce of *kharif* maize the stover was allowed to dry in the field itself and plot wise weight of the crop residue was recorded.

Nitrogen was applied at graded levels as per the treatments in four splits *i.e.*, one fourth at basal, one fourth at knee height stage, one fourth at flag leaf emergence and the remaining one fourth at tasseling stage.

Five plants from the destructive sampling area were cut to the base at 30 days interval and at harvest, sun dried and then oven dried at 60°C till a constant weight was obtained and expressed the dry matter in kg ha^{-1}.

Oven dried plant samples collected for dry matter estimation were finelypowdered and used for chemical analysis. The nutrient uptake was calculated by multiplying the nutrient content with respective dry matter and expressed as kg ha^{-1}. Samples collected from the crop residues from the plots were dried in shade and hot air oven to a constant weight and then ground into fine powder and used for estimation of nitrogen, content, employing the standard procedures as outlined by Jackson (1973) and the nutrient content of maize crop residue was expressed in per cent.

3. RESULTS AND DISCUSSION

Phosphorus uptake differed significantly due to residual nutrient effects (main plots) and nutrient doses ± crop residues (sub plots) and their interaction at different stages during both the years.

3.1 Phosphorus uptake at 30 days after sowing (DAS)

Phosphorus uptake differed significantly due to residual nutrient effects (main plots) and nutrient doses ± crop residues (sub plots) but their interaction was not significant during both the years (Table 1).

Crop sown in N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded significantly higher phosphorus uptake which was however on par with N_2P_3 (250 kg N + 80kg P_2O_5 ha^{-1}), N_1P_3 (200 kg N + 80 kg P_2O_5 ha^{-1}) and N_1P_2 (200 kg N + 60 kg P_2O_5 ha^{-1}) during the first year of study. Similarly during the second year N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded significantly higher phosphorus uptake, however it was on par with the remaining treatments except with the crop sown in N1P1 (200 kg N + 40 kg P_2O_5 ha^{-1}), N2P1 (250 kg N + 40 kg P_2O_5 ha^{-1})and N3P2 (300 kg N + 60 kg P_2O_5 ha^{-1}). Significantly lower phosphorus uptake was recorded in the crop sown in N3P2 (300 kg N + 60 kg P_2O_5 ha^{-1}) during both the years of study.

Phosphorus uptake in F2 (125% of F1) sub plot recorded significantly higher values which were however on par with F4 (F2+ *Kharif* crop residue incorporation) during the first year and the lowest phosphorus uptake was recorded in F3 (F1+ *Kharif* crop residue incorporation). In the second year, significantly higher phosphorus uptake was recorded in the sub plot F4 (F2+ *Kharif* crop residue incorporation) which was on par with F2 (125% of F1) and F3 (F1+ *Kharif* crop residue incorporation). The lowest phosphorus uptake was recorded in F1 (Recommended dose of N and P2O5).

Table 1. Uptake of phosphorus (kg ha^{-1}) by *rabi* maize at 30 DAS as influenced by crop residue and nutrient management practices

	***Rabi*, 2014**					***Rabi*, 2015**				
	F_1	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**
N_1P_1	3.7	3.8	3.1	3.2	**3.5**	4.2	4.4	3.0	4.7	**4.1**
N_1P_2	3.9	4.0	3.6	3.9	**3.9**	3.8	5.2	4.4	5.1	**4.6**
N_1P_3	3.9	4.0	3.4	4.0	**3.8**	4.7	5.6	4.0	4.8	**4.8**
N_2P_1	3.3	3.8	3.1	3.7	**3.5**	3.8	4.5	3.6	3.7	**3.9**
N_2P_2	3.5	4.0	3.4	4.0	**3.7**	4.5	5.6	4.9	4.7	**4.9**
N_2P_3	3.7	4.2	3.4	4.1	**3.9**	4.4	4.5	4.0	5.0	**4.5**

N_3P_1	3.5	4.0	3.3	3.5	**3.6**	4.7	4.8	4.5	4.8	**4.7**
N_3P_2	3.5	3.6	3.1	3.5	**3.4**	3.4	3.4	4.9	3.9	**3.9**
N_3P_3	4.2	4.3	4.1	4.2	**4.2**	4.5	4.6	4.9	6.3	**5.1**
Mean	**3.7**	**4.0**	**3.4**	**3.8**		**4.2**	**4.7**	**4.3**	**4.8**	

	***Rabi*, 2014**		***Rabi*, 2015**	
	SEm ±	**CD (P = 0.05)**	**SEm ±**	**CD (P = 0.05)**
NP	0.15	0.4	0.21	0.6
F	0.09	0.2	0.15	0.4
NP at F	0.26	NS	0.44	NS
F at NP	0.30	NS	0.42	NS

3.2 Phosphorus uptake at 60 DAS

Phosphorus uptake did not differ significantly due to residual nutrient effects (main plots), nutrient doses ± crop residues (sub plots) and their interaction during both years except due to residual nutrient effects (main plots)in the first year (Table 2).

Crop sown in N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded significantly higher phosphorus uptake which was however on par with N_3P_2 (300 kg N + 60kg P_2O_5 ha^{-1}), N_2P_3 (250 kg N + 80 kg P_2O_5 ha^{-1}) and N_2P_2 (250 kg N + 60 kg P_2O_5 ha^{-1}) during the first year of study. Similarly during the second year N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded higher phosphorus uptake however it was on par with the remaining treatments. Lower phosphorus uptake was recorded in the crop sown in N_1P_3 (200 kg N + 80 kg P_2O_5 ha^{-1}) and N_2P_1 (250 kg N + 40 kg P_2O_5 ha^{-1}) in the first and second years respectively.

Phosphorus uptake in F_2 (125% of F1) sub plot recorded higher values of phosphorus uptake which were however on par with the remaining sub plot means during both the years of study.

Table 2. Uptake of phosphorus (kg ha^{-1}) by *rabi* maize at 60 DAS as influenced by crop residue and nutrient management practices

	***Rabi*, 2014**					***Rabi*, 2015**				
	F_1	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**
N_1P_1	24.4	25.5	24.5	26.7	**25.3**	21.2	21.6	18.1	18.5	**19.9**
N_1P_2	23.9	25.8	23.5	24.7	**24.5**	21.1	22.1	20.6	22.8	**21.7**
N_1P_3	22.2	21.7	22.0	23.1	**22.2**	19.5	24.3	23.0	24.2	**22.7**
N_2P_1	21.2	24.9	20.4	23.4	**22.5**	21.5	22.6	19.6	21.1	**21.2**
N_2P_2	28.7	30.5	27.7	29.7	**29.1**	26.1	26.4	26.1	26.6	**26.3**
N_2P_3	29.5	32.1	31.0	30.7	**30.8**	29.0	29.7	28.6	30.8	**29.5**

N_3P_1	25.4	26.6	25.3	26.4	**25.9**	29.9	31.7	29.9	31.8	**30.8**
N_3P_2	27.1	28.9	26.7	28.7	**27.8**	29.1	31.7	28.7	30.0	**29.9**
N_3P_3	32.0	32.9	31.9	32.2	**32.2**	31.8	32.4	30.1	33.0	**31.8**
Mean	**26.0**	**27.6**	**25.9**	**27.3**		**25.5**	**26.9**	**25.0**	**26.5**	

	***Rabi*, 2014**		***Rabi*, 2015**	
	SEm ±	**CD (P = 0.05)**	**SEm ±**	**CD (P = 0.05)**
NP	1.68	5.0	4.09	NS
F	1.62	NS	1.81	NS
NP at F	4.54	NS	6.24	NS
F at NP	3.36	NS	8.17	NS

3.3 Phosphorus uptake at 90 DAS

Phosphorus uptake differed significantly due to residual nutrient effects (main plots), nutrient doses ± crop residues (sub plots) and their interaction during first year and due to residual nutrient effects (main plots) alone in the second year (Table 3).

Crop sown in N_2P_3 (250 kg N + 80 kg P_2O_5 ha^{-1}) recorded significantly higher phosphorus uptake which was however on par with N_3P_3 (300 kg N + 80kg P_2O_5 ha^{-1}), N_3P_1 (300 kg N + 40 kg P_2O_5 ha^{-1}) and N_2P_2 (250 kg N + 60 kg P_2O_5 ha^{-1}) during the first year of study. Similarly during the second year N_2P_3 (250 kg N + 80 kg P_2O_5 ha^{-1}) recorded significantly higher phosphrous uptake however it was on par with N_3P_1 (300 kg N + 40 kg P_2O_5 ha^{-1}), N_2P_2 (250 kg N + 60 kg P_2O_5 ha^{-1}), N_2P_1 (250 kg N + 40 kg P_2O_5 ha^{-1}), N_1P_3 (200 kg N + 80 kg P_2O_5 ha^{-1}) and N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}). Significantly lower phosphorus uptake was recorded in the crop sown in N_1P_1 (200 kg N + 40 kg P_2O_5 ha^{-1}) during both the years.

Phosphorus uptake in F_2 (125% of F_1) sub plot recorded higher values which were on par with F_4 (F_2+ *Kharif* crop residue incorporation) and significantly lower phosphrous uptake was recorded in F_1 (Recommended dose of N and P_2O_5) during the first year. Similar trend was observed in during the second year but there was no significant difference among the sub plot treatments.

Significant interaction was observed during the first year with regard to phosphorus uptake at 90 DAS. At the same level of main plot means F_2 (125% of F_1) recorded significantly higher phosphorus uptake in N_1P_2 (200 kg N + 60 kg P_2O_5 ha^{-1}), N_2P_3 (250 kg N + 80 kg P_2O_5 ha^{-1}) over F_1 (Recommended dose of N and P_2O_5) and N_3P_1 (300 kg N + 40 kg P_2O_5 ha^{-1}) over F_3, while F_4 (F_2 + *Kharif* crop residue incorporation) recorded significantly superior phosphorus uptakeat N_2P_1 (250 kg N + 40 kg P_2O_5 ha^{-1}) over F_3. At the same level of sub plot means the main plot treatments of N_3P_1 (300 kg N + 40 kg P_2O_5 ha^{-1}) at F_1 (Recommended dose of N and P_2O_5) and N_2P_3 (250 kg N + 80 kg P_2O_5 ha^{-1}) at F_2 (125% of F_1), F_3 (F_1+

Kharif crop residue incorporation) and F_4 (F_2+ *Kharif* crop residue incorporation) treatments recorded significantly higher phosphorus uptake. The lowest phosphorus uptake was recorded with N_1P1 (200 kg N +40 kg P_2O_5 ha^{-1}) at all sub plot levels.

Table 3. Uptake of phosphorus (kg ha^{-1}) by *rabi* maize at 90 DAS as influenced by crop residue and nutrient management practices

	***Rabi,* 2014**					***Rabi,* 2015**				
	F_1	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**
N_1P_1	30.4	39.6	31.7	38.0	**34.9**	33.3	41.2	35.3	37.4	**36.8**
N_1P_2	33.9	43.6	38.8	40.0	**39.0**	37.4	45.1	43.4	43.8	**42.4**
N_1P_3	43.5	52.2	48.0	51.0	**48.7**	45.7	52.2	50.5	51.6	**50.0**
N_2P_1	47.5	50.9	43.8	55.3	**49.4**	51.9	52.1	50.6	52.6	**51.8**
N_2P_2	53.2	58.5	52.8	54.4	**54.7**	51.2	55.4	52.3	52.2	**52.8**
N_2P_3	52.0	64.3	53.2	58.0	**56.9**	53.1	55.5	53.3	53.8	**53.9**
N_3P_1	54.2	60.8	46.7	54.2	**54.0**	51.8	52.1	48.3	51.5	**50.9**
N_3P_2	47.0	53.1	48.3	49.8	**49.6**	47.8	50.1	48.6	48.3	**48.7**
N_3P_3	50.9	53.6	52.6	53.5	**52.6**	49.6	51.1	49.2	51.6	**50.4**
Mean	**45.8**	**53.0**	**46.2**	**50.5**		**46.9**	**50.5**	**48.0**	**49.2**	

	***Rabi,* 2014**		***Rabi,* 2015**	
	SEm ±	**CD (P = 0.05)**	**SEm ±**	**CD (P = 0.05)**
NP	1.73	5.2	1.57	4.7
F	1.03	2.9	1.41	NS
NP at F	3.19	9.3	3.98	NS
F at NP	3.45	9.0	3.14	NS

3.4 Phosphorus uptake by stover

Phosphorus uptake differed significantly due to residual nutrient effects (main plots) during both the years, while due to nutrient doses ± crop residues (sub plots) in the first year alone. The interaction was not significant during both the years (Table 4).

Crop sown in N_3P_2 (300 kg N + 60 kg P_2O_5 ha^{-1}) recorded significantly higher phosphorus uptake in the first year which was however on par with N_3P_3(300 kg N + 80 kg P_2O_5 ha^{-1}) and N_3P_1 (300 kg N + 40 kg P_2O_5 ha^{-1}). In the second year of study N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded higher phosphorus uptake which was on par with N_3P_2 (300 kg N + 60 kg P_2O_5 ha^{-1}) and N_3P_1 (300 kg N + 40 kg P_2O_5 ha^{-1}). Significantly lower phosphorus uptake was recorded in N_1P_2 (200 kg N + 60 kg P_2O_5 ha^{-1}) during both the years, while it was on par with N_1P_1 (200 kg N + 40 kg P_2O_5 ha^{-1}), N_1P_3 (200 kg N

+ 80 kg P_2O_5 ha^{-1}) and N_2P_3 (250 kg N + 80 kg P_2O_5 ha^{-1}) in the first year and with all the main plot treatments except with N_3P_2 (300 kg N + 60 kg P_2O_5 ha^{-1}) and N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) in the second year.

Significantly higher phosphorus uptake recorded in sub plot F_2 (125% of F_1), which were however on par with F_3 (F_1+ *Kharif* crop residue incorporation) and F_4 (F_2+ *Kharif* crop residue incorporation) in the first year. During the second year F_4 (F_2+ *Kharif* crop residue incorporation) sub plot recorded higherphosphorus uptake but there was no significant difference with other sub plots.

Table 4. Phosphorus uptake by stover (kg ha^{-1}) in *rabi* maize as influenced by crop residue and nutrient management practices

	***Rabi*, 2014**					***Rabi*, 2015**				
	F_1	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**
N_1P_1	23.9	26.1	24.8	23.1	**24.5**	23.4	24.3	23.4	24.0	**23.8**
N_1P_2	22.4	23.7	22.8	22.1	**22.8**	22.6	23.2	23.2	23.5	**23.1**
N_1P_3	22.8	24.2	24.9	23.1	**23.8**	22.8	23.4	23.4	23.6	**23.3**
N_2P_1	26.3	29.0	28.1	29.2	**28.2**	23.7	24.1	24.7	25.0	**24.4**
N_2P_2	26.5	26.6	26.2	26.4	**26.4**	24.7	25.9	25.6	25.9	**25.5**
N_2P_3	25.2	25.3	24.1	25.3	**25.0**	23.9	24.2	24.8	25.0	**24.5**
N_3P_1	30.5	32.1	29.2	29.9	**30.4**	25.7	25.8	25.9	26.4	**26.0**
N_3P_2	28.5	34.9	33.1	30.9	**31.9**	26.9	28.1	28.1	27.9	**27.8**
N_3P_3	28.4	30.6	28.5	32.5	**30.0**	28.1	29.3	29.2	29.2	**29.0**
Mean	**26.1**	**28.1**	**26.9**	**26.9**		**24.6**	**25.4**	**25.4**	**25.6**	

	***Rabi*, 2014**		***Rabi*, 2015**	
	SEm ±	**CD (P = 0.05)**	**SEm ±**	**CD (P = 0.05)**
NP	0.96	2.9	1.10	3.3
F	0.46	1.3	0.45	NS
NP at F	1.54	NS	1.60	NS
F at NP	1.93	NS	2.20	NS

3.5 Phosphorus uptake by grain

Phosphorus uptake did differ significantly due to to residual nutrient effects (main plots) during both the years, while due to nutrient doses ± crop residues (sub plots) in the first year alone. The interaction was not significant during both the years (Table 5).

Crop sown in N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded significantly higher phosphorus uptake during both the years, which was however on par with N_3P_2 (300 kg N + 60 kg P_2O_5 ha^{-1}) and N_3P_1 (300 kg N + 40 kg P_2O_5 ha^{-1}) during the first year and with N_3P_2 (300 kg N + 60 kg P_2O_5 ha^{-1}), N_3P_1 (300 kg N + 40 kg P_2O_5 ha^{-1}), N_2P_3 (250 kg N + 80 kg P_2O_5 ha^{-1}) and N_2P_2 (250 kg N + 60 kg P_2O_5 ha^{-1}) in the second year of study. Significantly lower phosphorus uptake was recorded in the crop sown in N_1P_2 (200 kg N + 60 kg P_2O_5 ha^{-1}) during both the years.

Phosphorus uptake in the sub plot F_2 (125% of F1) recorded significantlyhigher values, which was however on par with F_4 (F_2+ *Kharif* crop residue incorporation) and F_1 (Recommended dose of N and P_2O_5) sub plots in the first year. Similar trend was observed in during the second year but there was no significant difference between the sub plot treatments.

Table 5. Phosphorus uptake by grain (kg ha^{-1}) in *rabi* maize as influenced by crop residue and nutrient management practices

	***Rabi,* 2014**					***Rabi,* 2015**				
	F_1	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**
N_1P_1	35.3	36.0	36.0	36.2	**35.9**	37.4	37.8	37.1	38.0	**37.6**
N_1P_2	33.9	33.9	33.2	35.0	**34.0**	34.2	36.4	32.6	38.3	**35.4**
N_1P_3	37.7	40.5	37.5	40.7	**39.1**	38.3	42.0	40.7	43.4	**41.1**
N_2P_1	40.1	45.8	38.2	40.2	**41.1**	38.5	47.0	43.1	44.6	**45.8**
N_2P_2	50.0	46.5	42.9	47.8	**46.8**	50.1	51.9	50.3	52.1	**51.1**
N_2P_3	49.8	50.4	43.9	47.2	**47.8**	52.9	53.4	52.7	53.9	**53.2**
N_3P_1	57.3	54.0	50.8	49.9	**53.0**	54.8	55.3	55.4	56.5	**55.5**
N_3P_2	50.9	59.7	53.7	54.6	**54.7**	56.2	58.6	52.3	53.6	**55.2**
N_3P_3	53.0	55.6	55.2	61.4	**56.3**	56.3	57.1	57.0	57.9	**57.1**
Mean	**45.3**	**46.9**	**43.5**	**45.9**		**46.5**	**49.9**	**46.8**	**48.7**	

	***Rabi,* 2014**		***Rabi,* 2015**	
	SEm ±	**CD (P = 0.05)**	**SEm ±**	**CD (P = 0.05)**
NP	1.54	4.6	2.86	8.6
F	1.20	3.3	1.48	NS
NP at F	3.48	NS	4.79	NS
F at NP	3.08	NS	5.72	NS

Table 6. Grain yield (kg ha^{-1}) of *rabi* maize as influenced by cropresidue and nutrient management practices

	***Rabi,* 2014**					***Rabi,* 2015**				
	F_1	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**

N_1P_1	6864	6999	6990	7024	**6969**	7055	7116	6998	7152	**7080**
N_1P_2	6954	6969	6813	7185	**6980**	6421	6838	6129	7197	**6646**
N_1P_3	6413	6890	6375	6919	**6649**	5881	6456	6252	6670	**6315**
N_2P_1	6746	7704	6431	6767	**6912**	5819	7421	6521	6749	**6628**
N_2P_2	7990	7436	6862	7649	**7484**	7130	7384	7148	7409	**7268**
N_2P_3	7738	7828	6815	7339	**7430**	7366	7433	7334	7493	**7406**
N_3P_1	7864	7406	6972	6852	**7273**	7183	7249	7261	7408	**7275**
N_3P_2	6765	7931	7129	7252	**7269**	7363	7677	6858	7024	**7230**
N_3P_3	6931	7259	7213	8026	**7357**	7359	7458	7441	7561	7455
Mean	**7140**	**7380**	**6844**	**7224**		**6842**	**7226**	**6882**	**7185**	

	***Rabi*, 2014**		***Rabi*, 2015**	
	SEm ±	**CD (P = 0.05)**	**SEm ±**	**CD (P = 0.05)**
NP	144.4	433	321.5	964
F	110.1	310	135.3	381
NP at F	320.4	NS	476.5	NS
F at NP	288.9	NS	643.1	NS

The highest grain yield of hybrid maize was produced with the application of 125% recommended dose of N and P_2O_5 alone, however comparable with crop residue incorporation, application of 100% recommended dose of N and P_2O_5 alone, while it was found to be the lowest with the application of 100% recommended dose of N and P_2O_5 along with crop residue incorporation. The higher level of grain yield was due to the favourable influence of consistent and adequate availability of nutrients especiallynitrogen throughout the crop growth period, which favoured the production of more photosynthates coupled with better partitioning to the sink, under higher levelof nutrients. The results are in conformity with the findings of Singh*et al.* (2000) and Ramu (2005).

4. CONCLUSION:

Residues of corn did not affect the phosphorus uptake and the nutrients released from corn residue is not a major contributor for subsequent corn nutrient uptake in sandy loam soils as is evidenced with highest nutrient uptake in the plots received with 125 % recommended dose either with or without residue incorporation. Similar results were obtained by Kevin *et al.*, (2010) in medium textured silty loam soils.

APPENDIX

Table 7. Quantity of maize residues incorporated (kg ha^{-1})

Treatments	Quantity (kg ha^{-1})	
	***Kharif*, 2014**	***Kharif*, 2015**
N_1P_1	8364	9325
N_1P_2	8113	12949
N_1P_3	7516	10580
N_2P_1	8507	10397
N_2P_2	9252	13309
N_2P_3	9123	12141
N_3P_1	8601	11277
N_3P_2	10797	13461
N_3P_3	8432	12812

Table 8. Nutrient content (%) in residues of maize (on dry weight basis)

Treatments	Nutrient content (%)					
	***Kharif*, 2014**			***Kharif*, 2015**		
	N	**P_2O_5**	**K_2O**	**N**	**P_2O_5**	**K_2O**
N_1P_1	0.86	0.20	1.89	0.84	0.21	1.64
N_1P_2	0.96	0.30	1.94	0.74	0.27	1.46
N_1P_3	1.02	0.33	2.20	0.70	0.26	1.76
N_2P_1	0.99	0.29	2.25	0.91	0.27	2.45
N_2P_2	0.94	0.32	1.98	0.70	0.24	1.90
N_2P_3	0.88	0.26	1.84	0.77	0.34	1.57
N_3P_1	1.06	0.29	2.39	0.91	0.41	2.39
N_3P_2	0.91	0.35	2.53	0.86	0.31	2.04
N_3P_3	1.05	0.35	2.01	0.87	0.28	1.62

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