INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com Volume-4, Issue-4, Oct-Dec-2013 Coden : IJABPT Copyrights@2013
ISSN : 0976-4550

Received: 29th August-2013 *Revised: 08th Sept-2013* *Accepted: 13th Sept-2013*

Research article

INFLUENCE 0F TOP DRESSING OF PHOSPORUS THROUGH COMPLEX FERTLIZERS ON NUTRIENT UPTAKE AND ECONOMICS OF RICE

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ABSTRACT: A field experiment was conducted to study the effect of top dressing of phosphorus through complex fertilizers on rice during *kharif* 2009 on clayey soil at Agricultural college farm Bapatla. Phosphorus uptake was significantly influenced due to sources of P at different times of application. Significantly higher P uptake in grain and straw was recorded with application of P as basal and at maximum tillering stages either through DAP or by 20:20:0 which was on a par with three splits of DAP and 20:20:0 and basal application of DAP, SSP and 20:20:0. The available P in soil was found significant among the treatments at 30 DAT, whereas, at 60 and 90 DAT and at maturity, it was non significant. The available nitrogen and potassium in soil after the harvest of rice crop was found non significant. Gross and net returns and benefit cost ratio were higher with application of P through DAP in two equal splits at basal and maximum tillering stages followed by 20:20:0; whereas, BCR was the highest with DAP in three splits.

Key words: Top dressing, Phosphorus, Nutrient uptake, Economics

INTRODUCTION

The availability of P to rice grown on waterlogged soils depends on composition of fertilizers and time of fertilizer application. Normally the entire dose of P is applied as basal for rice crop. But more often, due to various reasons, it is not always possible to apply the entire P at the time of transplanting as required. Under such circumstances, it is appropriate to know whether split applications of P or delayed application is permissible without any loss in yield. The efficiency of P was low when the total amount was applied as basal, which might be due to high P fixation. Farmers are preferring complex fertilizers due to their several advantages over straight fertilizers and obtaining higher yields. It is to be proved that whether the higher yields are due to P alone in complex fertilizers or any other nutrient has to be ascertained.

MATERIALS AND METHODS

The experiment was conducted at Agricultural College Farm, Bapatla, campus of Acharya N G Ranga Agricultural University (ANGRAU), located in the Krishna Agro-climatic Zone of Andhra Pradesh, the experimental soil was clay in texture, slightly alkaline in reaction, low in organic carbon and available nitrogen, medium in available phosphorus and high in available potassium. $T_{1:}$ SSP as basal, T_2: DAP as basal,T_3: 20:20:0 as basal, T_4 : DAP in two equal splits at basal and maximum tillering stage , T_5 :20:20:0 in two equal splits at basal and maximum tillering stage,T_6 : DAP in two equal splits at basal and panicle initiation (PI) stage, T_7:20:20:0 in two equal splits at basal and PI stage,$T_{8\,:}$ DAP in three equal splits at basal, maximum tillering and PI stage,T_9 : 20:20:0 in three equal splits at basal, maximum tillering and PI stage. All treatments arranged in Randamized Block Design with three replications. Rice seedlings (28 days old) were transplanted by adopting spacing 20 cm X 15 cm. a recommended dose of 120-60-40 kg N-P_2O_5-K_2O ha^{-1} was applied uniformly to all plots. All the K and Zn in the form of MOP and $ZnSO_4$@50 kg ha^{-1} were applied as basal. N applied in three splits, 1/3 each at basal, maximum tillering and panicle initiation stages. Phosporus was applied as per the treatments at different stages.

The treatments which received straight fertilizer as SSP, entire dose of nitrogen was applied through urea. While applying DAP and 20-20-0, the nitrogen content was taken into account and remain nitrogen was applied through urea. Recommended agronomic practices and plant protection measures were followed. The statistical analysis as prescribed by Pase and sukhatme (1978).

RESULTS AND DISCUSSION

Basal application of phosphorus either through SSP or DAP (T_1 and T_2) resulted in significantly increased P uptake at 30 DAS over rest of the treatments which were, however, on a par with DAP in two splits (T_4). The lowest P uptake (2.37 kg ha^{-1}) observed with two splits of 20:20:0 (T_5) on a par with T_7, T_3, T_9 and T_8. At 60 DAT, DAP in two splits (T_4) recorded significantly higher (8.59 kg ha^{-1}) P uptake over all other treatments except with that of 20:20:0 in two splits (T_5) and DAP in three splits (T_8). Application of P through 20:20:0 in two splits (T_7) recorded significantly lower (4.15 kg ha^{-1}) P uptake compared to rest of the treatments. Among the other treatments, 20:20:0 in three splits (T_9) was on a par with basal application of DAP and SSP (T_2 and T_1). At 90 DAT, significantly the highest P uptake (13.13 kg ha^{-1}) was registered with DAP in two splits (T_4) over all other treatments, except with DAP in three splits (T_8). The differences in P uptake among the rest of the treatments were not discernible. Recommended dose of P through DAP in two equal splits (T_4) recorded significantly higher (11.48 kg ha^{-1}) P uptake by grain at maturity over all other treatments. Phosphorus through 20:20:0 in two splits (T_5) was the next higher one in recording the higher P uptake, but on a par with T_8, T_9, T_1 and T_2. The lowest (6.36 kg ha^{-1}) P uptake of grain was recorded with 20:20:0 in two splits (T_7), which was on a par with T_6 and T_3. The P uptake in straw, was significantly the highest (7.01 kg ha^{-1}) with DAP in two splits (T_4) and it was on a par with that of two splits of 20:20:0 (T_5) and three splits of DAP (T_8). The lowest (3.27 kg ha^{-1}) uptake was registered with basal application of 20:20:0 (T_3) which was on a par with that of SSP (T_1) and basal application of DAP (T_2). Among the remaining treatments, T_9 was comparable with T_5 and T_8. Tandon (1987) opined that the modern high yielding varieties continue to absorb P till maturity and almost 70-80% of the absorbed P ends up in the panicles or earheads. This may be the reason that three splits of DAP and 20:20:0 was on a par with two splits of DAP and 20:20:0 at basal and maximum tillering stage. The positive effect of split application at basal and maximum tillering on P uptake was reported by Ramaiah (1979). The P absorbed during the period of active tillering was more effectively utilized for grain production.

Table 1: Phosphorus uptake of rice as influenced by sources of phosphorus at different times of application

Treatments		Phosphorus uptake (kg ha^{-1})				
		30 DAT	60 DAT	90 DAT	Maturity Grain	Maturity Straw
T_1	SSP (basal)	3.93	6.10	9.56	8.69	3.39
T_2	DAP (basal)	3.84	6.70	9.95	8.66	4.06
T_3	20:20:0 (basal)	2.61	5.93	9.40	7.74	3.27
T_4	DAP (½ basal + ½ max. tillering)	3.41	8.59	13.13	11.48	7.01
T_5	20:20:0 (½ basal + ½ max. tillering)	2.37	8.16	11.03	9.64	6.88
T_6	DAP (½ basal + ½ PI stage)	3.17	5.79	11.08	6.41	5.69
T_7	20:20:0 (½ basal + ½ PI stage)	2.41	4.15	9.39	6.36	4.57
T_8	DAP (1/3 basal + 1/3 max. tillering + 1/3 PI stage)	2.87	7.71	11.94	9.10	6.68
T_9	20:20:0 (1/3 basal + 1/3max. tillering + 1/3 PI stage)	2.85	7.20	11.37	9.02	5.73
	SEm (±)	0.21	0.37	0.67	0.56	0.34
	CD (P=0.05)	0.62	1.10	2.02	1.68	1.02
	CV (%)	11.68	9.46	10.85	11.34	11.27

Available Phosphorus in Soil

At 30 DAT, significantly the maximum (75.0 kg ha^{-1}) available P in soil was recorded when RD of P was applied through 20:20:0 as basal (T_3) which was on a par with T_2, T_1, T_5 and T_4. The minimum available P (40.8 kg ha^{-1}) was recorded with RD of P through 20:20:0 in two splits (T_7) and it was on a par with T_6. The results of available P in soil (Table 4.8) showed that application of P at the vegetative stage of plants maintained a higher value of available P in soil up to 30 DAT. Similar non significant difference in available phosphorus in soil at maturity due to different phosphatic fertilizers was also reported by Nandi and Mandal (1979) and Pawar and Chavan (1996).

Residual Nutrient Status of the Soil after Harvest of the Rice Crop

Available nitrogen in soil after the harvest of rice crop due to different sources and times of application of phosphorus was found to be non significant. The maximum (219 kg ha^{-1}) was observed when P was applied through DAP in two splits (T_6) followed by three splits (T_8). The minimum (186 kg ha^{-1}) was observed through 20:20:0 as basal (T_3). Available potassium in soil due to sources and times of phosphorus application was found to be non significant. The maximum (295 kg ha^{-1}) available potassium was recorded with 20:20:0 as basal (T_3) followed by T_7 and T_6. Whereas, the minimum (268 kg ha^{-1}) was noticed when RD of P was applied through DAP in two equal splits (T_4). The lowest available nitrogen in soil was observed with application of 20:20:0 as basal, which might be due to the presence of part of N (9%) in nitrate form and in a reduced system of flooded rice soil NO_3-N cannot remain as a stable ion, and is lost in the process of denitrification (Hundal and Sekhon, 1975). However, the lowest available phosphorus (54.83 kg P_2O_5 ha^{-1}) and potassium (295 kg ha^{-1}) was recorded with basal application of 20:20:0. Similarly, Pawar and Chavan (1996) also reported that the available N and P_2O_5 content of soil after harvest of rice crop were non-significant.

Table 2: Available Phosphorus in soil at different growth stages of rice as influenced by sources of phosphorus at different times of application

Treatments		Available Phosphorus (kg P_2O_5 ha^{-1})			
		30 DAT	60 DAT	90 DAT	Maturity
T_1	SSP (basal)	73.0	70.9	67.5	64.9
T_2	DAP (basal)	73.1	70.2	66.9	64.2
T_3	20:20:0 (basal)	75.0	71.6	68.1	66.5
T_4	DAP (½ basal + ½ max. tillering)	69.2	63.4	58.9	53.5
T_5	20:20:0 (½ basal + ½ max. tillering)	70.8	64.8	61.9	56.5
T_6	DAP (½ basal + ½ PI stage)	44.1	71.5	66.2	65.2
T_7	20:20:0 (½ basal + ½ PI stage)	40.8	69.1	63.8	62.3
T_8	DAP (1/3 basal + 1/3 max. tillering + 1/3 PI stage)	53.7	68.8	64.6	60.7
T_9	20:20:0 (1/3 basal + 1/3max. tillering + 1/3 PI stage)	55.1	70.7	66.6	63.2
	SEm (±)	3.7	4.7	4.3	3.3
	CD (P=0.05)	11.1	NS	NS	NS
	CV (%)	10.4	11.9	11.5	9.2

Economics

The highest gross and net returns and benefit cost ratio (60299 Rs.ha^{-1}, 46285 Rs.ha^{-1} and 3.30 respectively) were obtained with DAP in two equal splits at basal and at maximum tillering stage (T_4) followed by RD of P through 20:20:0 in two splits (T_5). The lowest gross and net returns and BCR (51215Rs.ha^{-1}, 36718 Rs.ha^{-1} and 2.53 respectively) were with 20:20:0 in two splits at basal and PI stage (T_7). The highest net returns (60299 Rs. ha^{-1}), gross returns (46285 Rs. ha^{-1}) and benefit cost ratio (3.30) were recorded with two splits of DAP at basal and maximum tillering stage because of higher grain and straw yields obtained with the use of these fertilizers. Gurmani *et al.* (1984) also reported the highest benefit cost ratio with Urea + DAP than with Urea + SSP and Urea + Nitrophos.

Table 3: Available nitrogen and potassium in soil after harvest of rice as influenced by sources of phosphorus at different times of application

Treatments		Available Nitrogen (kg ha^{-1})	Available Potassium (kg ha^{-1})
T_1	SSP (basal)	208	279
T_2	DAP (basal)	210	281
T_3	20:20:0 (basal)	186	295
T_4	DAP (½ basal + ½ max. tillering)	198	268
T_5	20:20:0 (½ basal + ½ max. tillering)	190	272
T_6	DAP (½ basal + ½ PI stage)	219	285
T_7	20:20:0 (½ basal + ½ PI stage)	217	289
T_8	DAP (1/3 basal + 1/3 max. tillering + 1/3 PI stage)	203	275
T_9	20:20:0 (1/3 basal + 1/3max. tillering + 1/3 PI stage)	199	277
	SEm (±)	12.89	17.78
	CD (P=0.05)	NS	NS
	CV (%)	10.98	11.00

Table 4: Economics of rice as influenced by sources of phosphorus at different times of application*

Treatments		Gross Returns Rs. ha^{-1}	Cost of cultivation	Net returns Rs.ha^{-1}	Benefit-cost ratio
T_1	SSP (basal)	56977	14393	42583	2.96
T_2	DAP (basal)	57299	14014	43285	3.09
T_3	20:20:0 (basal)	56827	14570	42258	2.90
T_4	DAP (½ basal + ½ max. tillering)	60299	14014	46285	3.30
T_5	20:20:0 (½ basal + ½ max. tillering)	59101	14497	44604	3.08
T_6	DAP (½ basal + ½ PI stage)	51419	14014	37404	2.67
T_7	20:20:0 (½ basal + ½ PI stage)	51215	14497	36718	2.53
T_8	DAP (1/3 basal + 1/3 max. tillering + 1/3 PI stage)	57647	14016	43631	3.11
T_9	20:20:0 (1/3 basal + 1/3max. tillering + 1/3 PI stage)	57385	14498	42887	2.96

*** Data not analyzed statistically**

Input costs			**Output costs**		
Seed	:	Rs.15.0 kg^{-1}	20:20:0	:	Rs.7.16 kg^{-1}
DAP	:	Rs.9.70 kg^{-1}	$ZnSO_4$	:	Rs.19.0 kg^{-1}
Price of paddy	:	Rs.10.5 kg^{-1}			
SSP	:	Rs.3.70 kg^{-1}	Labour wage	:	Rs.150 day^{-1}
Price of straw	:	Rs.1.0 kg^{-1}			
Urea	:	Rs.5.02 kg^{-1}	Tractor	:	Rs.500 hr^{-1}
MOP	:	Rs.4.63 kg^{-1}	Carbofuron granules	:	Rs.60 kg^{-1}

CONCLUSIONS

Phosphorus uptake in grain and straw at maturity were significantly influenced due to sources of P and time of application. Significantly higher P uptake in grain (11.48 kg ha^{-1}) and straw (7.01 kg ha^{-1}) was recorded with split application of DAP followed by 20:20:0 in two equal splits at basal and maximum tillering stage and it was on a par with three splits of DAP and 20:20:0.

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Application of DAP and 20:20:0 at basal and panicle initiation was found to be significantly inferior to all other treatments. The residual N, P_20_5 and K_20 after harvest of rice crop were non significant.

The maximum gross (60299 $Rs.ha^{-1}$) and net returns (46285 $Rs.ha^{-1}$) and benefit cost ratio (3.30) were realized with two splits of DAP at basal and maximum tillering stage followed by two splits of 20:20:0 at basal and PI stage.

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