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M RayJr. Scientis, Department of
Agronomy, RRTTS, Keonjhar,
Odisha, India**KC Sahoo**ADR, RRTTS, Keonjhar,
Odisha, India**TR Mohanty**Agrometeorologist, AICRP on
Agrometeorology, Bhubaneswar,
Odisha, India**M Prusty**Jr. Scientis, Department of Soil
Science, RRTTS, Mahisapat,
Odisha, India**SK Sahoo**Jr Agronomist, AICRP on
Linseed, RRTTS, Keonjhar,
Odisha, India**S Tudu**Jr Agronomist, AICRP on
linseed, RRTTS, Keonjhar,
Odisha, India**Corresponding Author:****M Ray**Jr. Scientis, Department of
Agronomy, RRTTS, Keonjhar,
Odisha, India

Nutrient management of paira crops in rice fallow

M Ray, KC Sahoo, TR Mohanty, M Prusty, SK Sahoo and S Tudu**Abstract**

An experiment was conducted at Field Experimental Block, Regional Research and Technology Transfer Station, Keonjhar, during Kharif - Rabi season of 2018-19 and 2019-20 to find out the suitable nutrient management practices of paira crops in rice fallow. The experiment was laid out in a Split-plot Design. The treatments combination comprised 5 nutrient management practices in the main plot viz. N₁: Farmers' practice (RDF to rice i.e 60-30-30 kg N:P₂O₅:K₂O/ha & no fertilizer to paira crop), N₂: Recommended 'P' dose of paira crop to rice as basal, N₃: Recommended 'P' dose of paira crop to rice at P.I. stage, N₄: Recommended 'P' dose of paira crop to rice two days before sowing of paira crop and N₅: Foliar application of water soluble fertilizer (18:18:18) @ 1% at 10 days before and at initiation of flowering of paira crop and 3 paira crops in the sub plot viz. chickpea, field pea and lathyrus. Results revealed that application of recommended 'P' dose of paira crop to rice at P. I. stage registered the maximum mean grain yield of 751 kg/ha. The yield increment was 29% over the control. Among the paira crops, lathyrus produced the maximum mean yield of 872 kg/ha followed by field pea (583 kg/ha) and chickpea (516 kg/ha). The highest net return of Rs 12041/- and B:C of 1.58 per ha was obtained when recommended 'P' dose of paira crop to rice at P. I. stage was applied. Among the paira crops, lathyrus produced the maximum net return of Rs 14963/- and B:C of 1.75 per ha.

Keywords: Nutrient management, paira crop, phosphorus dose, rice**Introduction**

Paira cropping is sowing of second crop after the flowering stage, before harvesting of the main crops (Rice) (Sharma *et al.*, 2004) [23]. Paira or Relay cropping is usually followed where long duration rice is harvested late with high soil saturation and there is water scarcity during the later stages of crop growth. Therefore to save and increase the yield of the second crop at a later stages paira cropping is done (Hedayetullah *et al.*, 2018) [12]. Paira/utera cultivation is mainly practiced to use the residual moisture left by the preceding crop during the rabi season (Palaniappan and Sivaraman, 1996) [17]. Under this condition short duration pulses can be broadcasted on the standing rice crop at least 2-3 weeks before harvesting. There will be no delay in sowing due to the land preparation. The crop germinates before the harvest of rice utilising the residual moisture (Sharma *et al.*, 2004) [23]. This is called paira cropping (Agarwal *et al.*, 1986) [1]. Paira crop is grown as bonus crop in conserved moisture under rice based system. (Chandrakar 2012) [6].

It is a general practice of the farmers to sow various winter pulse crops like lentil (*Lens culinaris* L.), lathyrus (*Lathyrus sativus* L.), chickpea (*Cicer arietinum* L.) and pea (*Pisum sativum*) in the standing rice crop field, just before the harvest to ensure germination using the residual moisture and to avoid tillage operations during pulse growing. (Gupta. S and Bhowmick., 2005) [11]. Presently Lathyrus is third important legume after chickpea and pigeon pea, predominantly grown in India (Bhagat *et al.*, 2015) [4]. In some areas *Paira* cropping of grass pea and lentil is followed under rice fallow situation after harvesting of rice in residual soil moisture, but growing of chickpea is also possible in low to medium land ecosystem (Bitew and Asargew., 2014) [5]. According to Pande *et al.*, 2012 [18] low to medium land soil characterised by clay loam soil with high water holding capacity is suitable for chickpea as the residual soil moisture of this soil is sufficient for chickpea plant growth and development. Lathyrus is the most commonly grown paira crop followed by linseed, mustard and lentil in West Bengal and Odisha (Das and Bhanja., 1996) [8]. Its superiority in terms of grain yield has been confirmed in many locations (Patra *et al.*, 1998, Barik and Sahoo., 1990, Das and Das., 1998) [20, 3, 9]. Rice- field pea in West Bengal (Das and Das., 1998) [9] and Rice- Chickpea paira cropping in Odisha (Barik and Sahoo., 1990) [3] fetched highest net profit among different prevailing cropping systems.

Although paira cropping is a boon under rice based system, there are many constraints in getting more production, one of them is inadequate fertiliser use. Therefore improved nutrient management practices can be adopted to increase the yield of paira crops.

Among the nutrients phosphorus is the major constraint in Indian agriculture due to its meagre natural deposit, high price and its deficiency in Indian soils. As phosphorus is not mobile, about 15 to 20% is utilised by the crop and rest remains in a fixed state. Phosphorus is a key nutrient which improves nitrogen fixation, quality and quantity of legumes and rice (Baired *et al.* 2010) [2] but due to several constraints, like prices of phosphatic fertilizers which is increasing day-by-day, lack of supply of fertilizers at proper time and soil properties, they restricts the application of full dose of phosphorus at proper time. Under such situations, marginal farmers are not able to utilize full recommended dose of P fertilizers at the time of sowing (Verma *et al.* 2002) [25]. Phosphatic fertilizers are well known to have a carry-over effect on the succeeding crops due to utilization efficiency of applied phosphatic fertilizers seldom exceeds to 15% by the first crop and a substantial amount of P is left as residue for the next crop. Studies on legume-based cropping system have shown that utilization efficiency of applied P fertilizers is low due to long spell of winter season. (Singh *et al.*, 2012) [24].

The rice based paira cropping system is mainly practised in the eastern states of India, namely Chhattisgarh, Jharkhand, West Bengal, Odisha and eastern Madhya Pradesh (Mondal *et al.*, 2004) [16]. In Keonjhar district of Odisha sowing of field peas by paira method is common. Patra *et al.*, 1998 [20] reported that at Keonjhar, Odisha, out of eight paira cropping systems tested, Rice- field pea was the most economic system with a net profit of Rs 892/ha. The crop responds very well to phosphorus application. In this system the seeds are broadcasted with little or more force so that they get 0.5 to 1 cm into the mud. This system is called chhata in Odisha (Mishra, 2004) [21]. In favourable condition the crop gives good yields (Lenka and Jena., 2002) [14]. Application of P fertilizer to paira crops not required because it has been already given to the preceding rice crop. The residual value of P is gaining importance under various cropping systems (Prasad *et al.*, 1989) [21]. Patel *et al.*, 1997 [19] reported that the residual effect of P applied to each preceding crop showed positive and significant response on the yield of succeeding crop when applied @ 100% recommended dose. Masthan *et al.*, 1999 [15] reported that an application of 62.2 kg P/ha to rice significantly increased the yield of rice and residual effect on succeeding mustard in rice-mustard-green gram. Keeping these issues in view a field experiment was conducted at Regional Research and Technology Transfer Station, Keonjhar, to effect of nutrient management of paira crops in rice fallow.

Material and Method

The experiment was conducted at Field Experimental Block, Regional Research and Technology Transfer Station, Keonjhar, during *Kharif-Rabi* season of two consecutive years of 2018-19 and 2019-20. The weather conditions which prevailed during the growing season were favorable for growth and development of the rice crop followed by the paira crops. Monsoon commenced in the second week of June

and terminated in the last week of September. The rainfall during the crop season were 1094.9 mm and the minimum and maximum temperature was 9.1 °C and 34.5°C. During this period, the relative humidity was maximum 61.6 to 83.7% and 18.3 to 62.1% was minimum. The experimental field was loamy sand in texture having pH 7.8 and electrical conductivity 0.14 ds/m. The organic carbon content was low (0.50%) while medium in available phosphorus (20.0 kg/ha) and low in Nitrogen(110.0 kg/ha) and potassium (85.0 kg/ha). The experiment was laid out in a Split-plot Design. The treatments combination comprised 5 nutrient management practices in the main plot *viz.* N₁: Farmers' practice (RDF to rice i.e 60-30-30 kg N:P₂O₅:K₂O/ha & no fertilizer to paira crop), N₂: Recommended 'P' dose of paira crop to rice as basal, N₃: Recommended 'P' dose of paira crop to rice at P.I. stage, N₄: Recommended 'P' dose of paira crop to rice two days before sowing of paira crop and N₅: Foliar application of water soluble fertilizer (18:18:18) @ 1% at 10 days before and at initiation of flowering of paira crop and 3 paira crops in the sub plot *viz.* chickpea, fieldpea and lathyrus. The net size of each plot was 25.08 m² (7.6 m x 3.3 m). Paddy seeds were sown at the rate of 60 kg/ha. Row to row distance was made at 20 cm apart and seed was sown continuously in the row. Chickpea, fieldpea and lathyrus seeds were broadcasted in the standing rice crop field, just before the harvest to ensure germination using the residual moisture and to avoid tillage operations during pulse growing. All the three paira crops were broadcasted at higher seed rate than normal. Chickpea was broadcasted @ 100kg/ha, field pea @100 kg/ha and lathyrus @ 80 kg/ha. For effective weed management, Pendimethalin (1 kg *a.i.*ha⁻¹) was used in moist condition at evening hours in all the treatments just after sowing of rice. Other Intercultural operations were done as and when necessary. The yield attributes and grain yield was recorded at harvest and sun dried straw yield was recorded 15 days after harvest. In case of Chickpea, fieldpea and lathyrus, the plant height, number of branches and dry matter accumulation were recorded at physiological maturity stage of the crop growth and the yield attributes and grain yield was recorded at harvest.

Results

Application of recommended 'P' dose of paira crop to rice at P. I. stage registered the maximum mean grain yield of 751 kg/ha followed by application of 'P' dose of paira crop to rice 2 days before sowing of Paira i.e 689Kg/ ha. The yield increment was 29% and 18% respectively over the control.

Among the paira crops, lathyrus produced the maximum mean yield of 872 kg/ha followed by field pea (583 kg/ ha) and chickpea (516 kg/ha)

The highest net return of Rs 12041/- and B:C of 1.58 per ha was obtained when recommended 'P' dose of paira crop to rice at P. I. stage was applied. Among the paira crops, lathyrus produced the maximum net return of Rs 14963/- and B:C of 1.75 per ha.

Table 1: Yield and economics of nutrient management of paira crops in rice fallow

Treatment	Yield (kg/ha)			GR (Rs.)			NR(Rs./ha)			B:C		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Year	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
N1- FP (60-30-30)	556	611	584	24533	26739	25636	5935	8141	7038	1.32	1.44	1.38
N2-P of paira crop to rice as basal	601	641	621	26575	28438	27507	5854	7716	6785	1.28	1.37	1.33
N3- P of paira crop to rice at P.I. stage	715	786	751	31412	34113	32763	10690	13391	12041	1.51	1.65	1.58
N4- P of paira crop to rice 2 days before sowing of Paira	660	717	689	29016	31599	30308	8295	10877	9586	1.40	1.52	1.46
N5- WSF @ 1% at 10 days before and at flower initiation.	609	668	639	26822	29138	27980	6758	9074	7916	1.34	1.46	1.40
Sem(±)	14.1	22.8	12.8									
CD(0.05)	46	74	42									
C1-CP	508	523	516	27940	28766	28353	6842	7667	7255	1.32	1.36	1.34
C2-FP	573	592	583	22915	23688	23302	3416	4189	3803	1.18	1.22	1.20
C3-GP	804	939	872	32160	37562	34861	12262	17663	14963	1.61	1.89	1.75
Sem(±)	23.5	19.8	17									
CD(0.05)	69.3	59	50									

Conclusion

Application of recommended 'P' dose of paira crop to previous crop rice at P. I. stage fetches higher income as compared to growing paira crops without fertiliser. Among the paira crops (Chickpea, Fieldpea and Lathyrus), growing of lathrus after rice is more profitable.

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