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Improvement of lathyrus productivity through seed priming and foliar nutrition under rice-*utera* system

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ABSTRACT

The present investigation was undertaken at Pulses and Oilseeds Research Sub-station, Beldanga, Murshidabad, West Bengal for two consecutive rabi seasons to evaluate different levels of seed priming (no soaking, water soaking, 2% KH_2PO_4 solution and sprouted seeds) along with varying levels of foliar nutrition (no spray, water spray, 2% urea spray, 2% DAP spray and 2% KCl spray) using lathyrus variety Ratan (BioL 212). It was found that use of sprouted seeds significantly recorded the highest seed yield (1021.77 kg ha^{-1}). Next in order was seed soaking in 2% KH_2PO_4 solution (964.67 kg ha^{-1}). Among foliar treatments, 2% urea spray could significantly produce the highest seed yield (1040.00 kg ha^{-1}) and was closely followed by 2% DAP spray (983.75 kg ha^{-1}). The study indicated that sowing of either sprouted or 2% KH_2PO_4 soaked seeds followed by foliar spray of 2% urea or 2% DAP solution (twice) at pre-flowering stage and 10 days thereafter proved to be effective in improving growth and productivity of lathyrus in rice-utera system.

***Keywords*: Foliar nutrition, lathyrus productivity, rice-fallows, seed priming, *utera* system**

Lathyrus (*Lathyrus sativus* L.) is mostly grown on the residual soil moisture in rice-fallows as *utera* (relay) crop (Gupta and Bhowmick, 2005; Mondal and Ghosh, 2005). But low productivity especially under *utera* system is the major problem associated with this crop (Bhowmick *et al*., 2005). Even there is a limited scope for agronomic manipulation under rice-*utera* system although it has potential for increasing cropping intensity in considerable areas that remain idle after *aman* rice (Rautaray, 2008). Seed priming (pre-sowing seed soaking) is an important low cost technology to obtain better plant stand and higher crop yield. Pre-sowing soaking of seeds with KH_2PO_4, Na_2HPO_4, etc. or simple water was earlier reported to improve seed germination, seedling vigor and root growth early in the season, resulting in good establishment, better drought tolerance and more yield of crop plants (Solaimalai and Subburamu, 2004). Besides, foliar nutrition may be a useful option particularly for the areas where soil application of fertilizers often leads to locking or loss of nutrients. With this technique, nutrients can reach to the site of food synthesis directly, leaving no wastage (Bhowmick, 2008) and thereby the requirement of fertilizer may be cut short from a huge bulk to a handful. Information on these aspects in lathyrus under rice-*utera* system is scanty. Hence, the present investigation was taken up to identify a suitable seed priming method and fertilizer material appropriate for foliar nutrition with a view to enhance lathyrus productivity under relay (*utera*) cropping system.

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MATERIALS AND METHODS

A two-year field study was conducted during two consecutive *rabi* seasons at the Pulses and Oilseeds Research Sub-station, Beldanga, Murshidabad, West Bengal, located at $23^0 55^/$N latitude and $88^0 15^/$E longitude with an altitude of 19.0 m AMSL in the North Eastern Plain Zone (NEPZ) of India. The soil of the experimental site was clay loam in texture with pH 7.4, EC 0.18 dS m^{-1}, organic carbon 0.38%, available P_2O_5 50.0 kg ha^{-1}, available K_2O 80.0 kg ha^{-1} and available SO_4 22.4 kg ha^{-1}. Four kinds of seed priming treatments *viz.* no seed soaking, seed soaking in water for 6 hours, seed soaking in 2% KH_2PO_4 solution for 6 hours and use of sprouted seeds were evaluated in combination with five levels of foliar nutrition *viz.* no spray, water spray, 2% urea spray, 2% DAP (diammonium phosphate) spray and 2% KCl (muriate of potash) spray. The treatment combinations were assigned in factorial randomized complete block design with three replications, keeping individual plot size as 4 m x 3 m. A common basal dose of 20 : 40 : 20 : 20 kg N : P_2O_5 : K_2O : S ha^{-1} was given at 3 days prior to lathyrus sowing in between the rows of rice plants. Seeds of lathyrus variety Ratan (BioL 212) were subjected to priming treatments following a seed rate of 75 kg ha^{-1} and broadcasted in the standing *aman* rice field without any land preparation in the month of

November. Rice varieties used for relay cropping of lathyrus were IET 15847 and Krishna Hamsa (IET 9219) which were harvested in the months of December and November in first and second year respectively. As per treatments, two rounds of foliar spray were given - one at pre-flowering stage i.e. at 60-65 days after sowing (DAS) and the other at 10 days after the first spray. The *utera* crop was unirrigated (rainfed), uninoculated and harvested during last and second week of March in subsequent years. Total rainfall receipts were 12.3 and 52.6 mm in 4 and 7 numbers of effective rainy days during the crop growth period when maximum temperatures of 36.5 and 33.8^{0}C and minimum temperatures of 10.0 and 11.4^{0}C were registered in first and second year of experimentation, respectively. Plant height was recorded at 45 DAS and at harvest. Seed yields along with yield attributes were recorded at the time of crop harvest.

RESULTS AND DISCUSSION

Effect of seed priming

Seed yield along with most of the growth and yield attributes differed significantly due to different seed priming methods during both the years of study (Table 1). However, amongst seed priming treatments, use of sprouted seeds and KH_2PO_4 soaked seeds significantly recorded higher mean number of pods plant^{-1} (11.10 and 10.56, respectively), which, being one of the key determinants of seed yield (Table 1), resulted in higher mean seed yields of 1021.77 and 964.67 kg ha^{-1}, respectively (Table 2). Higher plant height, more number of branches plant^{-1}, seeds pod^{-1} as well as 100-seed weight (Table 1) were also registered under these treatments which ultimately exhibited yield advantages of 24.61 and 17.64%, respectively, compared with no soaking plots. Next in order was soaking of seeds in water, registering 7.75% yield advantage over no soaking. Comparatively better performance of crop plants under all the seed priming treatments except 'no soaking' could be attributed to their good establishment as well as tolerance to soil moisture stress, which might be explained due to a number of physico-chemical changes within the cytoplasm including greater hydration of colloids, higher viscosity and elasticity of the protoplasm, etc. (Solaimalai and Subburamu, 2004). Values of all the growth and yield attributes along with seed yield were, however, found to be the lowest when non-soaked (non-primed) seeds were sown (Table 1). Bhowmick (2010) and Bhowmick *et al.* (2010) earlier reported similar findings with lentil and chickpea, respectively.

Effect of foliar nutrition

Irrespective of seed priming methods, foliar spray of 2% urea solution could significantly increase the seed yield to the tune of 1040.00 kg ha^{-1}, and it was closely followed by foliar spray of 2% DAP solution (983.75 kg ha^{-1}) (Table 2). Yield advantages were also discernible due to foliar spray of 2% urea (31.88 and 19.77%) and 2% DAP (24.75 and 13.29%), compared with no spray and water spray, respectively. Higher yields due to urea and DAP spray could be obtained because of the respective improvement in terms of growth and yield attributes (Table 1). Similar results were earlier reported in chickpea (Bhowmick, 2006), lentil (Bhowmick, 2008; Gupta and Bhowmick, 2012) and lathyrus (Gupta and Bhowmick, 2013; Bhowmick *et al*., 2014). Ali and Kumar (2006) reported beneficial effect of foliar nutrition with 2% urea solution at the reproductive stage in most of the pulse crops. It might be due to the fact that pulses under rainfed condition often experience nitrogen deficiency at this stage, because nitrogen fixation usually declines at reproductive stage and this is preceded by a decrease in fixation rate per unit weight of root nodules which probably results from bacteriod decay in the oldest nodules or in other words, gradual degeneration of root nodules. Bhowmick *et al.* (2010 and 2013) also reported superiority of 2% urea solution over 3% KCl or only water as foliar spray in chickpea.

Effect of interaction

A perusal of data in table-2 revealed that the interaction between seed priming and foliar nutrition did not bring about any significant yield differences in both the years of study. Similar trend was recorded in case of growth and yield attributes. However, there was a noticeable increase in seed yield due to urea spray from 883.33 kg ha^{-1} (non-primed) to 900.00-1061.33 kg ha^{-1} (primed) in first year and from 1016.67 kg ha^{-1} (non-primed) to 1093.33-1236.67 kg ha^{-1} (primed) in second year. Yield levels under DAP spray varied from 786.67 and 933.33 kg ha^{-1} (non-primed) to 838.67-1027.33 and 980.00-1206.67 kg ha^{-1} (primed) in first and second year, respectively (Table 2). The crop could not perform well without any foliar spray or even with only water and 2% KCl spray when non-primed seeds were used.

Thus, from the above findings, it can be concluded that sowing of properly primed seeds (either sprouted or 2% KH_2PO_4 soaked) followed by two rounds of foliar spray with 2% urea or 2% DAP solution at pre-flowering stage and 10 days thereafter would be a

Table 1: Effect of treatments on growth and yield of lathyrus in rice-*utera* system during two years of experimentation

Treatment	Plant height (cm)				Yield attributes								Seed yield(kg ha^{-1})	
	45 DAS		Harvest		Branches plant^{-1}		Pods plant^{-1}		Seeds pod^{-1}		100-seed wt. (g)			
	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year
Seed priming														
No soaking	36.68	28.80	45.15	48.85	3.69	3.87	8.94	9.05	2.22	2.09	6.36	5.85	730.66	909.33
Water soaking	37.12	32.97	49.67	51.24	3.87	3.98	9.48	9.45	2.54	2.17	6.66	5.94	802.44	964.67
2% KH_2PO_4 soaking	38.14	35.97	52.28	52.56	3.92	4.04	10.70	10.41	2.76	2.30	7.04	6.00	910.00	1019.33
Sprouted seeds	40.64	38.12	53.99	55.76	4.26	4.22	11.55	10.65	3.00	2.52	7.18	6.19	938.20	1105.33
SEm(±)	**0.65**	**0.88**	**1.07**	**0.81**	**0.08**	**0.08**	**0.32**	**0.19**	**0.06**	**0.04**	**0.06**	**0.10**	**18.28**	**18.55**
LSD (P=0.05)	**1.86**	**2.52**	**3.07**	**2.33**	**0.23**	**0.24**	**0.90**	**0.55**	**0.18**	**0.10**	**0.17**	**NS**	**52.50**	**53.27**
Foliar nutrition														
No spray	36.98	31.18	46.45	48.75	3.68	3.89	9.18	9.15	2.44	2.10	6.64	5.80	674.66	902.50
Water spray	37.85	32.92	48.49	50.60	3.79	3.95	9.62	9.51	2.54	2.16	6.77	5.93	798.33	938.33
2% urea spray	39.20	36.31	54.20	55.38	4.29	4.18	11.25	10.78	2.87	2.49	6.95	6.17	963.33	1116.67
2% DAP spray	38.53	35.23	51.44	53.48	4.11	4.08	10.84	10.28	2.69	2.38	6.87	6.07	912.50	1055.00
2% KCl spray	38.16	34.20	50.77	52.30	3.81	4.03	9.95	9.75	2.63	2.23	6.81	6.00	877.75	985.83
SEm(±)	**0.73**	**0.98**	**1.20**	**0.91**	**0.09**	**0.09**	**0.35**	**0.22**	**0.07**	**0.04**	**0.07**	**0.12**	**20.44**	**20.73**
LSD (0.05)	**NS**	**2.81**	**3.44**	**2.61**	**0.26**	**NS**	**1.01**	**0.62**	**0.20**	**0.12**	**0.19**	**NS**	**58.70**	**59.56**

Table 2: Effect of interaction between seed priming and foliar nutrition on seed yield of lathyrus in rice-*utera* system (pooled)

Treatment	No spray		Water spray		2% urea spray		2% DAP spray		2% KCl spray		Mean
	1st Y	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	
No soaking	578.00	823.33	680.67	853.33	883.33	1016.67	786.67	933.33	724.67	920.00	820.00
Water soaking	695.33	880.00	750.00	916.67	900.00	1093.33	838.67	980.00	828.00	953.33	883.54
2% KH_2PO_4 soaking	711.33	920.00	866.67	970.00	1008.67	1120.00	997.33	1100.00	966.00	986.67	964.67
Sprouted seeds	714.00	986.67	896.00	1013.33	1061.33	1236.67	1027.33	1206.67	992.33	1083.33	1021.77
Mean	**788.59**		**868.33**		**1040.00**		**983.75**		**931.79**		**922.50**

Statistic	Seed priming (S)		Foliar nutrition (F)		Interaction (S × F)	
	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year
SEm (±)	**18.28**	**18.55**	**20.44**	**20.73**	**40.87**	**41.47**
LSD (0.05)	**52.50**	**53.27**	**58.70**	**59.56**	**NS**	**NS**

Note: DAS: Days after sowing; NS: Not significant promising low cost technology for improving growth and productivity of lathyrus in rice-fallows under rainfed *utera* system.

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