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To find out the effect of seed treatment and foliar nutrition on uptake of nutrients in Field pea under *Utera* system

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Abstract
A field experiment was conducted during *rabi* season of 2017-18 at Instructional cum Research Farm, Indira Gandhi Krishi Vishvavidhyalaya, Raipur, Chhattisgarh. *Utera* or *paira* cropping (relay cropping) is age old double cropping system under the rainfed conditions in which succeeding *utera* crop is directly broadcasted in the standing rice crop after the flowering stage (Sharma *et al*., 2004). Field pea are a valuable source of protein for both man and animals. The majority of pea proteins are storage proteins, or globulins, and the amino acid profile of these proteins determines their nutritional value. The experiment was laid out in Factorial Randomized Block Design having the combination of twelve treatments and three replications. The treatment consisted of two seed treatment and six foliar nutrients spray. Seed treatment, S_2: Seed treatment with *Rhizobium* + PSB + fungicide + Sodium molybdate @ 0.5 g kg^{-1} seed recorded higher growth character, yield attributes and seed yield than with S_1: Seed treatment with *Rhizobium* + PSB + fungicide under rainfed rice - *utera* condition. As regards to foliar nutrients F_5: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray was found superior among other foliar nutrient sprays in respect of growth characters, yield attributes and yield under rain fed rice - *utera* system.

Keywords: field pea, nutrients, *utera* system, foliar nutrition

Introduction
Pulses are an important source of stable protein food for the poor and the vegetarians which constitute a major population of the country. The Recommended Dietary Allowances (RDA) for adult male and female is 60 g and 55 g day^{-1} respectively. The per capita availability of pulses is @ 42 g per day. Its production is characterized by diversity of crops and their regional specificity based on adaptation to prevailing agro climatic conditions. (Annual Report DPD 2016-17). In India field pea over an area of 1.058 million hectares with a production of 1.011 million tonnes and productivity 955 Kilogram per hectare. In Chhattisgarh Field pea is grown over an area of 0.018 million hectares with a production of about 0.005 millon tonnes and productivity 400 kilogram per hectare. (India stat 2016-17). Field pea fixes and utilizes the atmospheric nitrogen in symbiotic association with *Rhizobium leguminosarum* bacteria. It also helps in enriching the N-fertility by decaying of roots and nodules. Combined application of *Rhizobium* and phosphate solubilizing bacteria have synergistic action and stimulate their activity, however it is largely depended upon rhizospheric and climatic conditions. Combined inoculation along with phosphate fertilization may possibly help further in increasing their growth and may help of P fertilizer. Seed inoculation with *Rhizobium* or PSB and the combined inoculation resulted in conspicuous increase in nodulation, nitrogenase activity, growth, yield and nutrient uptake by the crop over no inoculation. However, the increase was more pronounced with the combined inoculation than with the single ones (Shrivastav and Ahlawat, 1995) [6].
Rhizobium inoculation is a significant technology for the manipulation of rhizobia for improving crop productivity and soil fertility. Rhizobium inoculation can lead to establishment of large rhizobia in the rhizosphere and improved nodulation and nitrogen fixation even under adverse soil conditions (Peoples *et al.*, 1995). In Field pea rhizobium inoculation is the process of applying rhizobium inoculants to the Field pea seed before planting in order to increase the nitrogen fixation and nodulation of the Field pea roots. Inoculating Field pea provides adequate number of bacteria in the root zone, so that effective nodulation will take place.
Foliar spray technique helps the nutrients to reach the site of food synthesis directly, leading no wastage and quick supply of food and thereby reduce the requirement of fertilizers. Foliar nutrition can hasten the growth of a crop suddenly. It is also known that active nodulation of pulse crop stops after 55 to 60 days after sowing and at that time, the positive effect of supplying legume plants with supplemental nitrogen was found to have beneficial effects on enhancing growth and increasing seed yield by quick supply of nitrogen. In the NPK 19:19:19 is a complete water soluble, ideal fertilizer which provides all major macronutrients like N, P and K in a balanced ratio to the plants through foliar spray at the time of maximum requirement with the lowest losses. Crop management practices can be adopted by applying fertilizers through soil as well as foliage. Under rice fallow situation, there is no possibility of basal application of fertilizer for pulses, since the pulses are sown prior to harvest of rice crop and fertilizer incorporation becomes impossible. Under these circumstances foliar application of nutrients would be more appropriate, efficient and economical than the soil application (Balusamy and Meyyazhagan, 2000) [1].
Utera or *paira* cropping (relay cropping) is age old double

cropping system under the rainfed conditions in which succeeding *utera* crop is directly broadcasted in the standing rice crop after the flowering stage (Sharma *et al*., 2004) [5]. It is prevalent in shallow rainfed lowland ecosystem of Eastern India. This system is important for resource poor farmers as it incurs no expenditure on land preparation and irrigation. Also, the system improves the land use efficiency of a vast tract of rice fallow, smoothers weed, adds organic matter and nitrogen, especially when pulse crop is grown. Thus, it entails resource conservation technologies like zero tillage, no irrigation, crop diversification with legume, and organic matter build-up. In recent years, popularity of Field pea as *utera* crop is increased. Hence, an attempt is made to standardize the management practices for improving the productivity of rice-*utera* Field pea cropping system.

Material and Methods

The study was carried out at experiment field of Instructional cum Research Farm, Indira Gandhi Krishi Vishvavidhyalaya, Raipur, Chhattisgarh during *Rabi* season of 2017-18. To find out the effect of seed treatment and foliar nutrition on uptake of nutrients of Field pea under *utera* system. The soil of the experimental field was *Vertisols* with low, medium and high in N, P and K, respectively and neutral in reaction. The climate of the region is sub-humid to semi-arid. The experiment was laid out in Factorial Randomized Block Design having the combination of twelve treatments and three replications. The treatment consisted of two seed treatment and six foliar nutrients spray. The experiment was comprised of factor A. Seed treatments, S_1: Seed treatment with *Rhizobium* + PSB + fungicide and S_2: Seed treatment with *Rhizobium* + PSB + fungicide + Sodium molybdate @ 0.5 g kg^{-1} seed and factor B. Foliar nutrient spray, F1: Control (water spray), F2: 2% Neem coated urea spray at branching, F3: 2% Neem coated urea spray at branching and 15 days after 1st spray, F4: 0.5% NPK (19:19:19) spray at branching, F5: 0.5% NPK (19:19:19) spray at branching & 15 days after 1st spray, F6: 2% DAP spray at branching & 15 days after 1st spray. Field pea (*Pisum sativum* L.) variety Indira Matar-1 was sown 18th October, 2017 with a seed rate of 100 kg ha^{-1}. The crop was harvested on 2nd February 2018. The seed were broadcasted @ 100 kg ha^{-1} at 15 days before harvesting of the rice crop. To prevent the crop from soil and seed borne diseases, the seeds were treated with carbendazim @ 2.5 g kg^{-1} of seeds then by sodium molybdate @ 0.5g kg^{-1} seeds followed by Rhizobium culture @ 5 g kg^{-1} and PSB culture as per the treatment.

Results and Discussion

Among the foliar nutrient spray, significantly maximum nitrogen uptake in seeds (61.22 kg ha^{-1}) and stover (40.63) as well as total (101.85) were recorded with the F_5: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray as compared to other foliar nutrient sprays. However, it was comparable with F_6: 2% DAP spray at branching and 15 days after 1st spray. Higher uptake of nitrogen during growth period which increased photosynthesis, synthesis of protoplasm and protein for higher rate of mitosis. The higher protein content was found with application of enriched sap which might be due to foliar nutrition of macro elements with hormones, could improve the photosynthetic activity and enzymes carbohydrate transformation (Doss *et al.* 2013) [2]. In case of Phosphorus uptake among seed treatment, S_2: Seed treatment with *Rhizobium* + PSB + fungicide + Sodium molybdate @ 0.5 g kg^{-1} seed recorded significantly maximum uptake of phosphorus in seeds (3.54 kg ha^{-1}) and stover (5.34) as well as in total (8.88) over in S_1: Seed treatment with *Rhizobium* + PSB + fungicide. Phosphorus uptake in grain, stover and in total were observed significant due to seed treatment and foliar nutrient spray. The treatment F_5: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray as recorded maximum uptake of phosphorus in seeds (3.96 kg ha^{-1}), stover (6.17) and in total (10.12). Over rest of the treatments. However, it was at par with F_6: 2% DAP spray at branching & 15 days after 1st spray. In case of K uptake among seed treatment, S_2: Seed treatment with *Rhizobium* + PSB + fungicide + Sodium molybdate @ 0.5 g kg^{-1} seed recorded significantly maximum uptake of potassium in seeds (16.98 kg ha^{-1}) and stover (105.09) as well as in total (122.07) over S_1: Seed treatment with *Rhizobium* + PSB + fungicide. Potassium uptake in seeds, stover and in total were observed significant due to different foliar nutrient sprays and seed treatments. Treatments F_5: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray as compared to other foliar nutrient sprays recorded maximum uptake of potassium in seeds (21.67), stover (114.88) and in total (136.55) over rest of the treatment. However, it was at par with F_6: 2% DAP spray at branching & 15 days after 1st spray. Gowda *et al*.

Table 1: Phosphorus uptake by Field pea as influenced by seed treatment and foliar nutrient spray

Treatment		Phosphorus uptake (kg. ha^{-1})		
		Seed	Stover	Total
A. Seed treatments	S_1: Seed treatment with *Rhizobium* + PSB + fungicide	2.96	4.63	7.59
	S_2: Seed treatment with *Rhizobium* + PSB + fungicide + Sodium molybdate @ 0.5 g kg-^{1} seed	3.54	5.34	8.88
	SEm±	0.12	0.23	0.32
	CD (P= 0.05)	0.36	0.69	0.96
B. foliar nutrients spray	F_1 : Control (Water spray)	2.39	3.90	6.29
	F_2 : 2% Neem coated urea (NCU) spray at branching	2.72	4.28	7.00
	F_3 : 2% Neem coated urea (NCU) at branching and 15 days after 1st spray	3.21	4.57	7.78
	F_4 : 0.5% NPK (19:19:19) spray at branching	3.30	4.89	8.19
	F_5 : 0.5% NPK (19:19:19) spray at branching & 15 days after 1st spray	3.96	6.17	10.12
	F_6 : 2% Diammonium phosphate (DAP) spray at branching & 15 days after 1st spray	3.91	6.11	10.01
	SEm±	0.12	0.41	0.56
	CD (P= 0.05)	0.35	1.20	1.66
	Interaction (S x F)	NS	NS	NS

(2015) [15] found foliar spray of 19:19:19 @ 0.4% recorded significantly higher uptake of nitrogen, phosphorus and potassium (126.66, 28.79 and 47.02 kg ha^{-1}). A repeated application of small units of foliar fertilizers stimulates plant metabolism and increased nutrient uptake via. The roots can be observed. Found result is corroborated by (Yadav and Sharma 1997) [5].

Conclusion

Seed treatment, S_2: Seed treatment with *Rhizobium* + PSB + fungicide + Sodium molybdate @ 0.5 g kg^{-1} seed recorded higher growth character, yield attributes and seed yield than with S_1: Seed treatment with *Rhizobium* + PSB + fungicide under rainfed rice - *utera* condition. As regards to foliar nutrients F_5: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray was found superior among other foliar nutrient sprays in respect of growth characters, yield attributes and yield under rain fed rice - *utera* system.

Higher nitrogen, phosphorus and potassium uptake in seeds and stover as well as total were recorded with the S_2: Seed treatment with *Rhizobium* + PSB + fungicide + Sodium molybdate @ 0.5 g kg^{-1} seed in case of foliar nutrient higher nitrogen, phosphorus and potassium uptake in seeds and Stover as well as total were recorded with the F5: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray.

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