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# Impact of foliar spray of nutrients and seed treatment on economics and energetics of lathyrus (*Lathyrus sativus* L.) under relay cropping system

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**Abstract**
A field experiment was conducted at the Agronomy Research Farm of IGKV, Raipur, during the Rabi season of 2016. The experiment was laid out in Factorial Randomized Block Design with twelve treatments replicated thrice to study the energy consumption and economics involved in cultivation of lathyrus after rice. Energy analysis carried out revealed that among foliar spray of nutrients, highest gross return, net return and B:C ratio was found in treatment, 0.5% NPK (19:19:19) spray at branching & 15 days after 1st spray (29492.64, 18618.14, 1.712 Rs.ha$^{-1}$ respectively), where as in case of seed treatment, seed treatment with Sodium molybdate @ 0.5 g kg$^{-1}$ seed gave the maximum gross return, net return and B:C ratio (26475.39, 15583.39, 1.431 Rs.ha$^{-1}$ respectively). Highest energy output, energy output : input ratio and energy use efficiency was found in, 0.5% NPK (19:19:19) spray at branching & 15 days after 1st spray (55.32, 18.88, 14.30 MJ ha$^{-1}$ x10$^{-3}$ respectively), where as energy input found maximum in, 2% neem coated urea spray at branching and 15 days after 1st spray (3.54 MJ ha$^{-1}$ x10$^{-3}$), seed treatment with Sodium molybdate @ 0.5 g kg$^{-1}$ seed gave the highest energy output, energy output : input ratio and energy use efficiency (49.38, 16.74 and 12.67MJ ha$^{-1}$ x10$^{-3}$ respectively) where as energy input was found similar in both treatments of seed treatment (2.95MJ ha$^{-1}$ x10 $^{3}$).

**Keywords:** Lathyrus, Utera, Foliar spray, Seed treatment, Energetics

## 1. Introduction
Lathyrus is third important legume after chickpea and pigeon pea, predominantly grown in India. *Lathyrus* is rich in protein (28%) and minerals especially calcium, phosphorus and iron (Bhagat *et al.*, 2015) [4]. In India it is cultivated in 495.3 thousand hectares with the production of 456.0 thousand tonnes and average productivity was 921 kg ha$^{-1}$ (Anonymous, 2014) [2]. In Chhattisgarh it is cultivated in 358.22 thousand hectares with the productivity of 660 kg ha$^{-1}$ (Anonymous, 2016) [3]. Gupta *et al.* 2015, [7] found that Bilaspur and Rajnandgaon are highly stable districts for area, production and productivity of lathyrus crop. The overall growth rate of lathyrus production, area & productivity in Chhattisgarh during 1974 to 2013 was 0.94, 0.75 & 1.08 %, which is good growth rate for the last 37 years. Rice – lathyrus sequential cropping plays a significant role in total productivity of crops especially in Chhattisgarh plain zone (Raipur zone) of Chhattisgarh state. A set of resource conservation approaches in lathyrus cultivation popularly known as *utera* is being practiced profusely in many states of India including Chhattisgarh. Grass pea is one of the preferred legume seeds in low fertility soils and arid areas because of its outstanding tolerance of dry or flooding conditions (Campbell, 1997) [5]. Grass pea has many good qualities and suitability for relay cropping (grown on the residual soil moisture in rice-fallows as *paira*) with paddy rice and resistance to pests of stored grain. In recent years, oilseeds and legumes are receiving more attention owing to limited production and higher prices. There is a closer relationship between economics, energy and environment. To meet the growing demand of the increasing population and for exports, the productivity of land and labor need to be increased substantially which would require higher energy input and better management of food production systems. Moreover, the cost of energy resources has significantly increased. Therefore, the assessment of energy consumption for crop production is required to understand the improved use of energy resources. So the relay cropping system of lathyrus needs to be evaluated economically as well as in terms of energy-use efficiency.

## 2. Material and methods
The investigation was carried out during *rabi* season of 2016 at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India, situated at 21°4' N,

81°35' E, respectively and 290.20 meters above mean sea level. In experimental field the stubbles of rice after harvesting is left of 30 cm. height. 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 six foliar nutrients spray and two seed treatments. The experiment was comprised of factor A. Foliar nutrients, $F_1$: Control (No foliar nutrients spray), $F_2$: 2% Neem Coated Urea spray at branching, $F_3$: 2% Neem coated urea spray at branching and 15 days after 1st spray, $F_4$: 0.5% NPK (19:19:19) spray at branching, $F_5$: 0.5% NPK (19:19:19) spray at branching & 15 days after 1st spray, $F_6$: 2 % DAP spray at branching & 15 days after 1st spray, and next factor B. Seed Treatments, $S_1$: Control (No seed treatment) and $S_2$: Seed treatment with Sodium molybdate @ 0.5 g $kg^{-1}$ seed. Lathyrus (*Lathyrus sativus* L.) variety Prateek was used in the experiment and sowing was done on 17th October, 2017 as *paira* crop by broadcasting in standing rice field 15 days before harvesting of rice with a seed rate of 75 kg $ha^{-1}$. The crop was harvested on 7th February 2016. The data obtained in respect of economic observations and energetics were statistically analyzed by Analysis of variance method (Gomez and Gomez, 1984) [6]. Different economic indicators were calculated based on the existing market price of the inputs and outputs. Energy use efficiency and output- input ratio were calculated by using the formula of Mittal *et al.* (1985) [9].

## 3. Results and Discussion

The effect of foliar spray and seed treatment on economis and energetics of lathyrus under relay cropping system are summarised under following heads.

### Economics

### Effect of foliar spray of nutrients

The data reveal that the maximum gross realization (Rs. 29492.64 $ha^{-1}$), net realization (Rs.18618.14 $ha^{-1}$) and benefit : cost ratio (1.712) were received under $F_5$: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray among all treatments of foliar nutrients spray. The lowest gross realization (Rs. 20639.79 $ha^{-1}$), net realization (Rs.9765.29 $ha^{-1}$) and B:C ratio (0.898) were found under Control (No foliar nutrients spray). The higher gross realization, net realization and benefits: cost ratio in 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray obviously due to higher seed and stover yields.

A number of reports are available suggesting impact of foliar application of nutrients and seed treatment for maximizing the economics which confirm our findings; Kumar (2013) [8] noted that highest gross return (Rs.128592 $ha^{-1}$) in treatment receiving starter NPK spray @ 2 per cent + sulphur spray @ 2 per cent at 45 DAS and booster NPK spray @ 2 per cent + boron spray @ 0.15 per cent at 65 DAS. Mallesha (2013) [10] was recorded that foliar application of 1.0 per cent WSF recorded higher gross returns (Rs.66,897 $ha^{-1}$) and net returns (Rs.46, 147) and also benefit : cost ratio (3.21). With respect to stages of spray higher gross returns (Rs.60, 420 $ha^{-1}$) and net returns (Rs.40, 170 $ha^{-1}$) recorded with foliar application of WSF at peak flowering and pod development stage. But higher benefit cost ratio (3.04) was recorded with foliar application of WSF at peak flowering stage. Ali (2014) [1] observed that foliar application of 1.5 per cent WSF at flowering and pod development recorded higher gross return (Rs.55, 895 $ha^{-1}$), net return (Rs.37, 120 $ha^{-1}$) and B:C ratio (2.98) compared to 2 per cent DAP and other lower concentration foliar sprays. Mamathashree (2014) [11] concluded that foliar application of water soluble fertilizer 19:19:19 @ 2 per cent at peak flowering and pod developmental stage is requisite for better growth and yield of pigeon pea. It is quite evident from the findings which shows higher net returns (Rs. 33,976 $ha^{-1}$) and B:C ratio (2.7 Rs) of pigeon pea followed by foliar spray of 0:52:34 at 2 per cent Rs. 28, 518 $ha^{-1}$ and 2.5 respectively. Murali *et al.* (2014) [12] reported that, foliar application of 1.0 per cent WSF at both peak flowering and pod development stages recorded higher gross returns (Rs.68,049 $ha^{-1}$) and net returns (Rs.46, 299 $ha^{-1}$). But higher benefit cost ratio (3.28) was recorded with foliar application of 1.0 per cent WSF at peak flowering stage.

### Effect of seed treatment

Among the seed treatment, Seed treatment with Sodium molybdate @ 0.5 g $kg^{-1}$ seed received maximum gross realization (Rs. 26475.39 $ha^{-1}$), net realization (Rs. 15583.39 $ha^{-1}$) and B: C ratio (1.431). The minimum values of gross realization, net realization and per rupee invested were noted under over Control (No seed treatment).

### Effect of Interaction

Interaction effects were found to be non significant.

**Energetics:** Data shows that energy input and output as well as their efficiency was influenced by different foliar nutrient sprays and seed treatments.

### Effect of foliar spray of nutrients

The input energy of *utera* lathyrus remained the high for treatment F3: 2% Neem coated urea spray at branching and 15 days after 1st spray (4.81) while it was minimum in case of treatment Control (No foliar nutrients spray). 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray gained the maximum energy output (55.32) resulted in the highest output input ratio (13.15) as well as energy use efficiency (9.98 ) lowest values of these energy indicators was obtained by the treatment Control (No foliar nutrients spray). The highest energy output : input and energy use efficiency might be due to more energy output and yields obtained under 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray in comparison to Control (No foliar nutrients spray).

### Effect of seed treatment

Concerning to seed treatment, The input energy of *utera* lathyrus remained the same for both treatments but Seed treatment with Sodium molybdate @ 0.5 g $kg^{-1}$ seed gained the maximum energy output (49.38) resulted in the highest output input ratio (16.74) as well as energy use efficiency (12.67) lowest values of these energy indicators was obtained by the treatment Control (No seed treatment).

### Effect of Interaction

Interaction effects were found to be non significant.

**Table 1:** Economics of relay cropped lathyrus as influenced by different foliar nutrients spray and seed treatments.

| Treatment | Gross realization (Rs $ha^{-1}$) | Net realization (Rs $ha^{-1}$) | B : C ratio |
|---|---|---|---|
| A. Foliar nutrients Spray | | | |
| F1: Control (No foliar nutrients spray) | 20639.79 | 9765.29 | 0.898 |
| F2: 2% Neem coated urea spray at branching | 22190.77 | 11316.27 | 1.040 |
| F3: 2% Neem coated urea spray at branching and 15 days after 1st spray | 25918.11 | 15043.61 | 1.383 |
| F4: 0.5% NPK (19:19:19) spray at branching | 25510.35 | 14635.85 | 1.346 |
| F5: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray | 29492.64 | 18618.14 | 1.712 |
| F6: 2 % DAP spray at branching and 15 days after 1st spray | 26772.17 | 15897.67 | 1.462 |
| SEm± | 819.871 | 819.871 | 0.08 |
| CD (P = 0.05) | 473.353 | 473.353 | 0.22 |
| B. Seed Treatments | | | |
| S1: Control (No seed treatment) | 23699.22 | 12842.22 | 1.183 |
| S2: Seed treatment with Sodium molybdate @ 0.5 g $kg^{-1}$ seed | 26475.39 | 15583.39 | 1.431 |
| SEm± | 473.3527 | 473.3527 | 0.04 |
| CD (P = 0.05) | 1388.296 | 1388.296 | 0.13 |
| Interaction (F x S) | NS | NS | NS |

**Table 2:** Energy input and output relationship of lathyrus as influenced by influenced by different foliar nutrients spray and seed treatments

| Treatment | Input Energy (MJ ha-1x10-3) | Output Energy(MJ ha-1x$10^{-3}$) | Output: Input Ratio | Energy use efficiency,(q MJ x $10^{-3}$ $ha^{-1}$ ) |
|---|---|---|---|---|
| A. Foliar nutrients Spray | | | | |
| F1: Control (No foliar nutrients spray) | 2.60 | 40.99 | 15.76 | 11.98 |
| F2: 2% Neem coated urea spray at branching | 3.07 | 43.13 | 14.07 | 10.60 |
| F3: 2% Neem coated urea spray at branching and 15 days after 1st spray | 3.54 | 47.38 | 13.28 | 10.12 |
| F4: 0.5% NPK (19:19:19) spray at branching | 2.77 | 46.40 | 16.75 | 12.66 |
| F5: 0.5% NPK (19:19:19) spray at branching and 15 days after 1s spray | 2.93 | 55.32 | 18.88 | 14.30 |
| F6: 2 % DAP spray at branching and 15 days after 1st spray | 2.80 | 51.33 | 18.33 | 13.90 |
| SEm± | | 1.09 | 0.37 | 0.29 |
| CD (P = 0.05) | | 3.18 | 1.12 | 0.87 |
| B. Seed Treatments | | | | |
| S1: Control (No seed treatment) | 2.95 | 45.47 | 15.41 | 11.96 |
| S2: Seed treatment with Sodium molybdate @ 0.5 g $kg^{-1}$ seed | 2.95 | 49.38 | 16.74 | 12.67 |
| SEm± | | 0.63 | 0.22 | 0.17 |
| CD (P = 0.05) | | 1.84 | 0.65 | 0.50 |
| Interaction (F x S) | | NS | NS | NS |

## 4. Conclusion

The results in present has revealed that treatment $F_5$: 0.5% NPK (19:19:19) spray at branching and 15 days after 1st spray and treatment $S_2$: Seed treatment with Sodium molybdate @ 0.5 g $kg^{-1}$ will higher the cost of cultivation, highest energy output, energy output : input ratio and energy use efficiency. Energy input was found maximum in F3: 2% neem coated urea spray at branching and 15 days after 1st spray. Interaction effects of different treatments of both factors were found to be non significant.

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