Effect of different sources of organic manures and seed bio-priming on yield and economics of Rice bean (Vigna umbellate)

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Abstract
A field experiment was conducted during kharif-2019 at Research Institute of Organic Farming field unit, UAS, GKV, Bengaluru to study the Effect of different sources of organic manure and seed bio-priming on growth and yield of rice bean (Vigna umbellate) laid out in Factorial Randomized Complete Block Design with 10 treatments replicated thrice and the variety used was KBR-1. Results of the experiment revealed that seed bio priming with *Rhizobium* and *Trichoderma* recorded significantly higher seed yield (1184.87 kg ha⁻¹) and stover yield (3052.56 kg ha⁻¹), yield attributes like number of pods per plant (11.37 g) and 100% N equivalent through vermicompost resulted in significantly higher seed yield (1789.50 kg ha⁻¹) and stover yield (3504.47 kg ha⁻¹), yield attributes like number of pods per plant (69.67), pod length (9.92 cm), number of seeds per pod (12.83 g). Lower seed yield (237.3 kg ha⁻¹) and stover yield (1985.2 kg ha⁻¹) recorded T1 (without seed bio-priming). Whereas, higher B:C ratio (2.96) was recorded with 100% N equivalent through neemcake + seed bio-priming.

Keywords: Rice bean, bio-priming

Introduction
Rice bean (Vigna umbellate), a member of the leguminosae (Fabaceae) family, is an annual underutilized grain legume or pulse is native of south East Asia. It is newly introduced crop in Karnataka and is commonly known as red bean, Mambi bean, climbing mountain bean, Japanese rice bean, bamboo bean and oriental bean and considered as a potential grain legume because of its high protein content. In India, Rice bean is used for both food and fodder. Legumes in general are scarce, costly and defective in their nutritional and cooking qualities but rice bean seed protein is varies from 15-25 per cent. Rice bean has drawn special attention due to its high seed yield (22-25 q ha⁻¹). It is fairly drought tolerant and grows well on relatively poor soils. It has wider adaptability to different agro-ecologies and is highly resistant to viral diseases. Varieties and land races grow profusely, spreading and twinning type, with immediate growth. It is very sensitive to day length. Flowering and pod setting are initiated with the onset of short days (Singh and Tomer, 1989) [5].

Bio-priming is a new promising technique of seed treatment that integrates biological and physiological method of improving plant growth and controlling disease. It is recently used as an alternative method for controlling many seed and soil borne pathogens. Thus, considered as an advanced technique of seed treatment which includes of application of beneficial microorganism on seed surface and seed hydration (Singh et al., 2016) [6].

Materials and Methods
A field experiment was conducted during kharif 2019 at organic farming research and demonstration field unit (J block) of Research Institute on Organic Farming (RIOF), Gandhi Krishi Vignan Kendra (GKV), University of Agricultural Sciences, Bengaluru, to study the Effect of different organic manures and seed bio-priming on growth and yield of rice bean consisted of ten treatments replicated thrice in FRCBD. The soil was red sandy clay loam and the treatments tested where T1: without seed biopriming, T2: with seed biopriming, T3:100% N equivalent through neemcake + seed bio-priming.
equivalent through FYM+ seed biopriming, T₄: 100% N equivalent through Vermicompost + seed biopriming, T₅: 100% N equivalent through Neemcake + seed biopriming, T₆: 100% N equivalent through biodeigger liquid organic manure + seed biopriming, T₇: 100% N equivalent through FYM +without seed biopriming, T₈: 100% N equivalent through Vermicompost + without seed biopriming, T₉: 100% N equivalent through Neemcake + without seed biopriming, T₁₀: 100% N equivalent through biodeigger liquid organic manure + without seed biopriming. RDF: 40:20:20, basal dose application of FYM @10 t ha⁻¹ to all treatments except T₁ and T₂. Variety KBR-1 was sown at a spacing of 45 cm x 10 cm, gross and net plots size was 4.5 m x 3.5 m and 2.7 m x 3.1 m respectively.

Seed bio-priming (seed treatment)
Pre-soaked the seeds in water for 12 hrs then mixed the formulated product of bio-agents (Rhizobium and Trichoderma) with pre-soaked seeds at the rate of 10 g per kg of seeds with adhesive material castor oil (100 ml per kg seeds) and put the treated seeds as a heap then covered the heap with moist jute sack to maintain high humidity. Then kept for incubation under high humidity for about 48 hrs approximately 25-32 per cent. Bio-agents adhered to the seed grows on the seed surface under moist condition to form a protective layer all around the seed coat. Data on rice bean grain and stover yield collected after harvest of the crop and averaged over three replications. The data collected on different trait was statistically analysed using standard procedure and the results were tested at the five percent level of significance as given by Gomez and Gomez (1984) [4].

Gross returns (Rs. ha⁻¹)
The gross return per hectare was calculated by multiplying prevailing market price into total yield obtained per hectare. (Market price/unit quantity × grain yield + market price of straw × straw yield).

Net returns: Net returns were calculated by deducting the cost of cultivation from gross returns.

Net return = Gross return − Total cost of cultivation

Table 1: Yield attributes of rice bean at harvest as influenced by different sources of organic manures and seed bio-priming

| Treatment | No of pods plant⁻¹ | Pod length (cm) | No. of seeds per pod | Seed yield plant⁻¹ (g) | 1000 seed weight (g) |
|-----------|---------------------|----------------|----------------------|------------------------|---------------------|
| A. Seed bio-priming | | | | | |
| W₁ (With seed bio-priming) | 59.87 | 8.69 | - | 7.53 | 11.37 | 19.89 |
| W₂ (Without seed bio-priming) | 55.93 | 7.77 | - | 7.47 | 9.93 | 18.89 |
| F-test | * | * | NS | * | * | |
| S. Em± | 1.42 | 0.19 | 0.24 | 0.22 | 0.12 | |
| CD (p=0.05) | 4.22 | 0.56 | - | 0.66 | 0.37 | |
| B. Organic sources | | | | | |
| S₁ – control | 17.00 | 7.28 | 5.83 | 4.42 | 16.97 | |
| S₂ – FYM | 60.70 | 8.22 | 7.17 | 10.55 | 18.88 | |
| S₃ – Vermicompost | 69.00 | 9.92 | 9.17 | 12.83 | 21.22 | |
| S₄ – Neem cake | 62.67 | 8.25 | 7.77 | 11.33 | 20.22 | |
| S₅ – BDLM | 60.17 | 7.50 | 7.67 | 10.08 | 19.67 | |
| F-test | * | * | * | * | NS | |
| S. Em± | 2.25 | 0.30 | 0.39 | 0.35 | 0.20 | |
| CD (p=0.05) | 6.68 | 0.90 | 1.34 | 1.06 | - | |
| C. Interaction | | | | | |
| T₂ (W₁ S₁) | 22.3 | 7.5 | 7.0 | 9.3 | 17.1 | |
| T₃ (W₂ S₁) | 62.7 | 8.2 | 7.3 | 10.8 | 18.7 | |
| T₄ (W₁ S₂) | 71.3 | 10.5 | 8.3 | 14.0 | 22.0 | |
| T₅ (W₂ S₂) | 62.7 | 8.8 | 7.7 | 11.3 | 21.0 | |
| T₆ (W₁ S₃) | 60.3 | 8.5 | 7.3 | 10.6 | 20.6 | |

**Benefit cost ratio**
The benefit cost ratio was calculated by using the following formula:

\[
\text{Benefit cost ratio} = \frac{\text{Gross returns}}{\text{Cost of cultivation}}
\]

**Result and Discussion**
Yield parameters of rice bean like number of pods per plant (69.67), pod length (9.92 cm), number of seeds per pod (9.17) seed yield per plant (12.83 g), seed yield (1184. 87 kg ha⁻¹), stover yield (3052.56 kg ha⁻¹) and harvest index (0.27) were recorded significantly higher due to seed bio-priming with Rhizobium and Trichoderma. The reason might be due to the Trichoderma which helps to solubalize the tricalcium phosphate into the more available form, mineralization of other nutrients and also the production of hormones like indole acetic acid (IAA), gibberellic acid and cytokinin through microbial action (Argaw 2012; Elkoça et al., 2008) [1, 3].

Yield parameters of rice bean like number of pods per plant (69.67), pod length (9.92 cm), number of seeds per pod (9.17) seed yield per plant (12.83 g), seed yield (1789.50 kg ha⁻¹), stover yield (3504.74 kg ha⁻¹) and harvest index (0.33) were recorded significantly higher with T₄:100% N equivalent through vermicompost this is because humic and fulvic acids and other organic acids found in vermicompost as well as the frequency of nutrients, especially N which will stimulate the growth and increase number of pods (Bajracharya et al., 2009) [2].

**Economics**
This is the ultimate criteria for acceptance or rejection and wider adoption of any technology. Among the various treatments 100% N equivalent through neemcake + seed bio-priming recorded higher net returns and higher C:B ratio (2.96) compared to other treatments. This was attributed to neem cake contains more nutrients (N, P and K) per unit quantity of manure so less quantity is required to meet the crop requirements because of these reasons cost of cultivation will be comparatively less so net profit will be higher.
Glycine max is cultivated as a major crop in Assosa area. The effect on soybean [Glycine max (L.) Merril] in Assosa area. J Agric. Sci. and Technol 2012;4:213-224.

Table 2: Seed yield, stover yield and harvest index as influenced by different sources of organic manures and seed bio-priming

| Treatment | Seed yield (kg ha⁻¹) | Stover yield (kg ha⁻¹) | Harvest index |
|-----------|----------------------|------------------------|---------------|
| **A. Seed bio-priming** | | | |
| W₁ (With seed bio-priming) | 1184.87 | 3052.56 | 0.27 |
| W₂ (Without seed bio-priming) | 1116.47 | 2678.04 | 0.26 |
| F- test | * | NS | |
| S. Em± | 31.680 | 66.780 | 0.006 |
| CD (p=0.05) | 94.126 | 198.414 | - |
| **B. Organic sources** | | | |
| S₁ – control | 247.67 | 2116.15 | 0.10 |
| S₂–FYM | 1253.17 | 2692.09 | 0.31 |
| S₃–Vermicompost | 1789.50 | 3504.47 | 0.33 |
| S₄ - Neem cake | 1279.33 | 3065.51 | 0.29 |
| S₅– BDLM | 1183.67 | 2948.20 | 0.28 |
| F- test | * | * | * |
| S. Em± | 50.090 | 105.589 | 0.009 |
| CD (p=0.05) | 151.83 | 313.72 | 0.03 |
| **C. Interaction** | | | |
| T₁ (W₁; S₁) | 258.0 | 2247.1 | 0.10 |
| T₂ (W₁; S₂) | 1258.0 | 2982.5 | 0.29 |
| T₃ (W₁; S₃) | 1944.0 | 3799.9 | 0.33 |
| T₄ (W₁; S₄) | 1285.3 | 3262.9 | 0.28 |
| T₅ (W₁; S₅) | 1182.0 | 2970.5 | 0.28 |
| T₁ (W₂; S₁) | 237.3 | 1985.2 | 0.10 |
| T₂ (W₂; S₂) | 1248.3 | 2401.7 | 0.34 |
| T₃ (W₂; S₃) | 1635.0 | 3209.1 | 0.33 |
| T₄ (W₂; S₄) | 1270.0 | 2925.8 | 0.30 |
| T₅ (W₂; S₅) | 1176.7 | 2868.5 | 0.29 |
| F- test | NS | NS | |
| S. Em± | 70.83 | 149.32 | 0.01 |
| CD (p=0.05) | - | - | - |

Table 3: Economics of rice bean as influenced by different sources of organic manures and seed bio-priming

| Treatment No. | Treatment details | Cost of cultivation (Rs ha⁻¹) | Gross returns (Rs ha⁻¹) | Net returns (Rs ha⁻¹) | C:B Ratio |
|---------------|-------------------|-----------------------------|------------------------|----------------------|----------|
| T₁ | Without seed bio-priming | 9200 | 16590 | 7390 | 1.80 |
| T₂ | With seed bio-priming | 9500 | 18060 | 8560 | 1.90 |
| T₃ | 100% N equivalent through FYM + seed bio-priming | 40700 | 87500 | 46800 | 2.14 |
| T₄ | 100% N equivalent through vermicompost + seed bio-priming | 50700 | 135000 | 84300 | 2.18 |
| T₅ | 100% N equivalent through Neemcake + seed bio-priming | 30120 | 89360 | 59240 | 2.96 |
| T₆ | 100% N equivalent through biodigester liquid organic manure + seed bio-priming | 36760 | 82950 | 46250 | 2.26 |
| T₇ | 100% N equivalent through FYM + without seed bio-priming | 40400 | 87360 | 46960 | 2.44 |
| T₈ | 100% N equivalent through Vermicompost + without seed bio-priming | 50400 | 114100 | 63700 | 2.26 |
| T₉ | 100% N equivalent through Neemcake + without seed bio-priming | 29900 | 87900 | 59000 | 2.93 |
| T₁₀ | 100% N equivalent through biodigester liquid organic manure + without seed bio-priming | 40100 | 82040 | 41940 | 2.04 |

Conclusion
Seed bio-priming with *Rhizobium* and *Trichoderma* and 100% N equivalent through vermicompost gives better seed yield, stover yield and higher net profit compared to other treatments.

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