Effect of Different Organic and Inorganic Seed Priming Method on Growth, Yield and Quality Parameters of Field Pea (*Pisum sativum* L.)

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**ABSTRACT**

Pulses are referred to as poor man’s meat, as they are major sources of protein and complement the stable cereals in the diet with essential nutrients. Field pea is an annual cool season grain legume or pulse crop and majorly grown in rabi season and third most popular rabi pulse of India after chickpea and lentil. The study was conducted to determine the “Effect of different organic and inorganic seed priming method on growth, yield and quality parameters of field pea (*Pisum sativum* L.)” The experiment was carried out at Field Experimentation Centre and Seed Testing Laboratory of the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during Rabi-2019. The experiment was laid out in Randomized Blocked Design for field studies and Completely Randomized design for lab studies and comprised of 13 treatments and 3 replications. The treatments were $T_0$ (Control), $T_1$ (Distilled water), $T_2$ (Tulasi leaf extract@ 5%), $T_3$ (Pongamia Leaf Extract@ 5%), $T_4$ (Curry Leaf Extract@5%), $T_5$ (Moringa Leaf Extract@5%), $T_6$ (Neem Leaf Extract @ 5%), $T_7$ (KH$_2$PO$_4$@ 1%), $T_8$ (KH$_2$PO$_4$@ 3%), $T_9$ (KN$_3$ @ 1%), $T_{10}$ (KN$_3$ @ 3%), $T_{11}$ (GA$_3$ 100ppm), $T_{12}$ (PEG 6000 @20%) with a soaking duration of 12 hours. The results revealed that seeds primed with $T_{10}$ (KN$_3$ @ 3%) improved Germination%, Growth, yield and Seed quality Parameters followed by $T_6$ (Neem Leaf Extract @ 5%) and the least performance was observed in $T_0$ (control) when compared with other treatments. Hence, seed priming with (KN$_3$ @3%) and Neem Leaf Extract @5% could be recommended for field pea as a pre-sowing seed treatment.

**Keywords**

Field pea, GA$_3$, PEG 6000, KN$_3$, CaCl$_2$, KH$_2$PO$_4$, Aloe Vera extract, Curry leaf extract, Ginger extract, Moringa leaf extract, Tulasi leaf extract, Priming, Germination, CRD

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**Introduction**

Pulses are referred to as poor man’s meat, as they are major sources of protein and complement the stable cereals in the diet with essential nutrients. They occupy pivotal position particularly in developing countries like India, where most of the population is vegetarian. Pulses belong to the family Leguminosae and subfamily Papilionoidaceae. They provide 22-24 per cent protein and the seeds are considered
easily digestible and the increasing demand of protein rich raw material for animal feed or intermediary product for human nutrition, there is raising interest in these crops as a protein source (Santalla et al., 2001).

Field pea (Pisum sativum L.) is represented as one of the world’s most seasoned cultivated crop, before tenth and ninth centuries BC (Zohary, Hopf, 2000). Pisum sativum comprises of both the wild species (P. fulvum and P. eratius) and developed species (P. abyssinicum) started from the Mediterranean locale, principally in the Middle East (Ellis et al., 2011). The crop is cultivated in numerous nations and right now India’s position is fourth among the pulse production in the world with cultivated area of 6.33 million ha. (Source: Devi et al., 2017).

Field pea (Pisum sativum L.) is a temperate crop grown in higher altitudes in tropical areas with temperature ranging between 7-30°C. It is diploid with 2n=14, It is one of the sixth major pulse crops cultivated globally and is second highest yielding grain legume next to broad bean (Vicia faba). Field pea (Pisum sativum L.) is a self-pollinated rabi pulse crop which is developed for nourishment, feed and vegetables.

In India, Total pulse production is 25.23 M tonnes (2017-18) total area under pea production is 9.01 lakh ha and total production of 8.49 lakh tons were recorded. In India Uttar Pradesh ranked first both in area and production (37.90% and 41.58%) followed by Madhya Pradesh (38.67% and 32.98%) and Jharkhand (3.80% and 4.85%). In case of productivity Rajasthan holds first rank (1867 kg/ha) followed by Punjab (1297 kg/ha) and Jharkhand (1203 kg/ha). The lowest production was observed in Maharashtra (390 kg/ha) followed by Chhattisgarh (437 kg/ha). (Source: Annual statistical report2016-17).

Nutritional value for 100 g. includes energy-81 Kcal, Carbohydrates -14.45 g, Protein-5.42 g, Total fat- 0.40 g, Dietary fiber- 5.1 g, Cholesterol – 0 mg (Source: USDA National Nutrient data base)

Supply of good quality seeds is an important crucial point and it becomes imperative to evolve a strategy to produce quality seeds and made them available in time at a reasonable price to the farming community. Quality seed is the key for successful agriculture which demands that each and every seed should be ready to germinate and produce a vigorous seedling ensuring higher yield (Ananthi et al., 2015). Annual loses due to deterioration can be as much as 25 % of the harvested pulses crop. It is one of the basic reasons for low productivity (Shelar, 2008).

Seed invigoration techniques are used to enhance germination and vigor of seed and seedling growth. It includes the pre-soaking of seeds that improves seed performance by rapid and uniform germination, normal and vigorous seedlings, which result in faster and higher rate of germination and emergence in different crops (Farooq et al., 2007), which also helps seedlings to grow in biotic or abiotic stress condition (Ashraf and Foolad, 2005).

The benefits of priming are it decreases the time to germination. Increases the germination rate. Helps in uniform and faster emergence. Helps the crops in competing with weeds more effectively. Reduces the amount of seed borne fungi (Basra et al., 2004).

Materials and Methods

The experimental study was carried out at Field Experimentation Centre and Seed Testing Laboratory of the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture,
Technology & Sciences, Prayagraj (UP) during Rabi-2019.

The field experiment was conducted in Randomized block design (R.B.D) with three replications and the variety used in this experiment was IP. The data was collected on five randomly selected plants from each plot and measurement of different observations was recorded.

The lab experiment was conducted in Completely Randomised Design (C.R.D) with four replications and the variety used in this experiment was IP-. The data was collected on ten randomly selected healthy seedlings from each replication and measurement of different observations was recorded.

The treatments were T₀ (Control), T₁ (Distilled water), T₂ (Tulasi leaf extract @ 5%), T₃ (Pongamia Leaf Extract @ 5%), T₄ (Curry Leaf Extract @ 5%), T₅ (Moringa Leaf Extract @ 5%), T₆ (Neem Leaf Extract @ 5%), T₇ (KH2PO₄ @ 1%), T₈ (KH2PO₄ @ 3%), T₉ (KN03 @ 1%) T₁₀ (KN03 @ 3%), T₁₁ (GA₃ 100ppm), T₁₂ (PEG 6000 @ 20%) with a soaking duration of 12 hours.

| Priming Methods | Treatment Symbol | Treatments |
|-----------------|------------------|------------|
| T₀              | Control          | Unprimed seeds |
| T₁              | Distilled Water  | Hydro priming |
| T₂              | Tulasi leaf extract (5%) | Organic priming |
| T₃              | Pongamia leaf extract (5%) | Organic priming |
| T₄              | Curry leaf extract (5%) | Organic priming |
| T₅              | Moringa leaf extract (5%) | Organic priming |
| T₆              | Neem leaf extract (5%) | Organic priming |
| T₇              | KH2PO₄ (1%) | Halo priming |
| T₈              | KH2PO₄ (3%) | Halo priming |
| T₉              | KN03 (1%) | Halo priming |
| T₁₀             | KN03 (3%) | Halo priming |
| T₁₁             | GA₃ (100 ppm) | Harmonal priming |
| T₁₂             | PEG 6000 (5%) | Osmo priming |

**Preparation of solutions**

For preparation of solution, the required chemicals have been collected from Department of Genetics and Plant Breeding, Prayagraj and fresh leaves for organic priming were collected from Department of Horticulture Research Fields, SHUATS.

For the preparation of solutions of botanicals, fresh leaves (Tulasi, Pongamia, Curryleaf, Moringa, Neem) were shade dried and ground into fine powder. To make 5% solution, 5gm of each leaf powder was added to 100ml of distilled water in separate beakers.

For the preparation of 1% solution of KH₂PO₄, KN03 1gm of each salt was dissolved in distilled water to make the volume up to 100ml. For the preparation of 3% solution of KH₂PO₄, KN03 3gm of each was dissolved in distilled water to make the volume up to 100ml. For the preparation of 100 ppm GA₃ solution, 100mg of GA₃ was dissolved in 1000ml distilled water. For the preparation of 20% solution of PEG 6000, 20 g of PEG 6000 was dissolved in distilled water to make the volume up to 100ml.

After preparing all the above solutions, seeds of field pea were added to each of the prepared solution and soaked for about 12 hr.
at 25°C temperature. Untreated seed is known as control. After 12 hr of soaking, the solution was drained out from the beaker and pre-soaked seeds were air dried at room temperature to original weight and then placed for sowing and germination in the laboratory under controlled condition.

**Results and Discussion**

It is evident from the present investigation that priming treatments has significant effect on quality parameters in fenugreek. In general, most of the treatments have increased growth, yield, quality parameters as compared to control (untreated seeds). In terms of field parameters like Field emergence (%), Plant height (cm), Days to 50% flowering, Number of pods per plant, Number of seeds per pod, biological yield (g), seed yield per plot (g), Harvest index the treatment $T_{10}$ - KNO$_3$ @ 3% (Halopriming) recorded as highest followed by $T_6$ – Neem extract @ 5% (Organic priming), $T_2$ – Distilled water (Hydro priming).

Saed-Moochesi *et al.*, (2014) also found similar results in the maize seed KNO$_3$ and urea priming lead to high activities of antioxidant defensive enzymes and increase the tolerance level to abiotic stresses such as salt and drought which increased the emergence rate (Table 1 and 2).

**Table 1** Mean performance of growth and yield parameters in field pea

| S.No | Treatments | Field emergence (%) | Plant height (cm) | No of Branches | Days to 50% flowering | No. of pods per plant | No. of seeds per pod | Seed yield per plot | Biological yield | Harvest Index |
|------|------------|---------------------|-------------------|----------------|----------------------|----------------------|---------------------|-------------------|----------------|--------------|
| 1    | $T_0$      | 76.333              | 77.053            | 7.333          | 55.600               | 8.833                | 3.313               | 242.690           | 357.263         | 0.679        |
| 2    | $T_1$      | 86.867              | 89.667            | 9.333          | 49.600               | 12.733               | 3.660               | 527.940           | 651.830         | 0.810        |
| 3    | $T_2$      | 86.637              | 81.007            | 9.000          | 50.133               | 10.467               | 3.500               | 417.110           | 538.060         | 0.772        |
| 4    | $T_3$      | 79.833              | 83.720            | 9.333          | 58.000               | 10.400               | 3.347               | 488.863           | 604.697         | 0.792        |
| 5    | $T_4$      | 78.167              | 83.200            | 9.667          | 52.200               | 9.767                | 3.460               | 436.323           | 562.650         | 0.775        |
| 6    | $T_5$      | 83.237              | 85.993            | 9.000          | 51.000               | 12.000               | 3.620               | 348.073           | 473.200         | 0.734        |
| 7    | $T_6$      | 89.523              | 90.733            | 10.667         | 49.000               | 12.833               | 3.767               | 554.463           | 685.063         | 0.809        |
| 8    | $T_7$      | 82.377              | 80.827            | 8.667          | 57.467               | 10.667               | 3.553               | 347.233           | 467.567         | 0.739        |
| 9    | $T_8$      | 84.757              | 82.770            | 10.333         | 51.400               | 9.667                | 3.523               | 442.160           | 555.503         | 0.782        |
| 10   | $T_9$      | 78.080              | 82.093            | 8.667          | 54.667               | 9.667                | 3.470               | 394.593           | 499.653         | 0.774        |
| 11   | $T_{10}$   | **92.373**          | **92.383**        | **11.333**     | **47.833**           | **13.367**           | **4.000**           | **625.913**       | **732.080**     | **0.855**     |
| 12   | $T_{11}$   | 89.033              | 130.433           | 9.667          | 61.733               | 9.000                | 3.733               | 181.933           | 301.850         | 0.601        |
| 13   | $T_{12}$   | 78.000              | 86.070            | 10.000         | 52.800               | 10.100               | 3.447               | 366.783           | 490.473         | 0.741        |
|      | Grand mean | 83.47821            | 88.15205          | 9.461538       | 53.18718             | 10.73077             | 3.568718           | 413.3908          | 532.2992        | 0.758597     |

**C.D.** 2.742 1.610 0.59 1.772 0.655 0.226 163.221 165.163 0.069
**SE(m)** 0.934 0.548 0.715 0.603 0.223 0.077 55.590 56.251 0.023
**SE(d)** 1.321 0.775 1.011 0.853 0.316 0.109 78.616 79.551 0.033
**C.V.** 1.938 1.077 13.091 1.965 3.602 3.738 23.291 18.304 5.353
Table 2 Mean performance of seed quality parameters in field pea

| Treatments | Germination % | Root length (cm) | Shoot length (cm) | Seedling length (cm) | Seedling fresh weight (mg) | Seedling dry weight (mg) | Vigour index-I | Vigour index-II | Seed Index |
|------------|---------------|------------------|-------------------|----------------------|----------------------------|-------------------------|---------------|----------------|------------|
| T0         | 80.000        | 6.750            | 18.000            | 24.750               | 2.725                      | 1.300                   | 1,979.200     | 103.875        | 22.060     |
| T1         | 92.750        | 8.325            | 22.500            | 30.825               | 3.800                      | 1.738                   | 2,859.050     | 161.150        | 24.020     |
| T2         | 91.000        | 7.875            | 22.125            | 30.000               | 3.700                      | 1.625                   | 2,730.300     | 147.913        | 22.797     |
| T3         | 88.750        | 7.250            | 20.750            | 28.000               | 3.550                      | 1.475                   | 2,485.275     | 130.875        | 22.387     |
| T4         | 86.500        | 7.175            | 19.925            | 27.100               | 3.475                      | 1.388                   | 2,343.475     | 120.013        | 23.147     |
| T5         | 90.500        | 8.600            | 22.375            | 30.975               | 3.550                      | 1.700                   | 2,802.750     | 153.813        | 23.893     |
| T6         | 93.750        | 8.750            | 22.875            | 31.625               | 4.225                      | 1.888                   | 2,965.650     | 177.013        | 25.180     |
| T7         | 88.750        | 7.800            | 20.250            | 28.050               | 3.475                      | 1.470                   | 2,489.250     | 130.495        | 23.443     |
| T8         | 91.250        | 7.700            | 21.825            | 29.525               | 3.750                      | 1.590                   | 2,693.850     | 145.025        | 23.313     |
| T9         | 91.000        | 8.025            | 21.750            | 29.775               | 3.975                      | 1.650                   | 2,708.900     | 150.225        | 23.820     |
| T10        | 96.000        | 9.000            | 24.375            | 33.375               | 4.550                      | 2.188                   | 3,203.975     | 209.975        | 26.503     |
| T11        | 92.250        | 7.800            | 28.000            | 35.800               | 3.275                      | 1.525                   | 3,302.050     | 140.700        | 24.250     |
| T12        | 90.250        | 7.575            | 21.350            | 28.925               | 3.250                      | 1.638                   | 2,610.850     | 147.850        | 23.370     |
| Grand mean |               |                  |                   |                      |                           |                         |               |                |            |
| C.D.       | 1.646         | 0.251            | 1.477             | 1.494                | 0.220                      | 0.130                   | 138.652       | 12.169         | 1.207      |
| SE(m)      | 0.573         | 0.087            | 0.515             | 0.520                | 0.077                      | 0.045                   | 48.289        | 4.238          | 0.411      |
| SE(d)      | 0.811         | 0.123            | 0.728             | 0.736                | 0.108                      | 0.064                   | 68.290        | 5.994          | 0.582      |
| C.V.       | 1.271         | 2.210            | 4.676             | 3.479                | 4.210                      | 5.559                   | 3.569         | 5.742          | 3.004      |
Seed yield per plot is high in treatment combination of KNO$_3$ is due to the potassium (K) it is associated with the movement of water, nutrients and carbohydrates in plant tissues.

In terms of lab parameters like Germination (%), Root length (cm), Shoot length (cm), Seedling length (cm), Seedling fresh weight (g), Seedling dry weight (g), Vigour index I, Vigour index II the treatment T$_{10}$ - KNO$_3$ @ 3% (Halopriming) recorded maximum values, followed by T$_6$ – Neem leaf extract @5% (Organic priming), T$_{11}$ – GA3 @100ppm (Hormonal priming).

Muhammad Amjad et al., (2007), also found similar results by priming seeds with distilled water (hydro priming) and salts (halo priming) and observed that seeds treated with KNO$_3$(3%) showed increase of seed germination over control and all other treatments.

Mohammad Armin et al., (2010) investigated the effect of seed priming on germination and seedling growth of watermelon, and found that KNO$_3$ had the most effective impact on emergence and seedling growth. Compared with the non-primed seeds, seed priming with KNO$_3$ increased the germination by 17.87%.

On the basis of results obtained from the present investigation, it is concluded that seed priming improves germination, vigour, growth and yield parameters of field pea. Treated seeds performed better than untreated seeds(control). Of all the treatments, seed priming with T$_{10}$-KNO3 (3%)(Halo priming) recorded best results, followed by T$_6$-Neem leaf extract (5%)(Organic priming) and T$_1$-Distilled water(Hydro priming) for field parameters and seed priming with KNO3 (3%)(Halo priming) recorded best results, followed by T$_6$-Neem leaf extract (5%)(Organic priming) and T$_{11}$-GA3(100ppm) (Hormonal priming) for quality parameters.

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