GROWTH AND YIELD RESPONSE OF LEN S CULINARIS L. MEDIC. AND VIGNA RADIATA L. WILCZEK TO NITROGEN, PHOSPHORUS AND PYRIDOXINE APPLICATION

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Eight factorial randomised field experiments, four each on lentil (Lens culinaris L. Medic.) var. T-36 (Experiments 1-4) and summer moong (Vigna radiata L. Wilczek) var. K-851 (Experiments 5-8), were conducted at the University Farm of the Aligarh Muslim University, Aligarh (India) from 1984 to 1986. The aim was to study the effect of basally applied nitrogen and phosphorus and of pre-sowing seed treatment (prior to applying respective Rhizobium inoculum uniformly) with aqueous pyridoxine solution, alone and in combination, on growth parameters, net assimilation rate (NAR), nitrate reductase activity (NRA), leaf NPK content, yield parameters and seed protein content of these grain legumes. The data were mostly found significant and are summarised below.

Experiment 1: The trial was conducted during 1984-85. Four doses of nitrogen, i.e., 15, 30, 45 and 60 kg N/ha (B_{N15}, B_{N30}, B_{N45} and B_{N60}), were applied to plots given a uniform basal dose of 45 kg P and 30 kg K/ha. Seeds of lentil were soaked in aqueous pyridoxine solution, i.e., 0% (S_w), 0.2% (S_1), 0.3% (S_2) or 0.4% (S_3) before sowing. The individual and combined effects of these treatments were studied on growth parameters, NRA and leaf NPK content at 60, 90 and 120d; NAR for 60-90d and 90-120d intervals and yield parameters and seed protein content at harvest. Of these basal nitrogen doses, B_{N30} proved optimum for
most of the parameters. The soaking treatment $S_2$ promoted almost all parameters studied. The interaction $B_{N30} \times S_2$ proved optimum for most parameters. For example, $B_{N30} \times S_2$ increased seed yield by 71.21% and seed protein content by 12.65% over $B_{N15} \times S_W$.

**Experiment 2:** The trial was conducted during 1984-85. Four doses of phosphorus, viz., 15, 30, 45 and 60 kg P/ha ($B_{P15}$, $B_{P30}$, $B_{P45}$ and $B_{P60}$), were applied to plots given a uniform basal dose of 45 kg N and 30 kg K/ha. Seeds of lentil were soaked in pyridoxine solution, viz., 0% ($S_w$), 0.2% ($S_1$), 0.3% ($S_2$) or 0.4% ($S_3$) before sowing. The individual and combined effects of these treatments were studied on growth parameters, NRA and leaf NPK content at 60, 90 and 120d; NAR for 60-90 and 90-120d intervals and yield parameters and seed protein content at harvest. Of these, $B_{P30}$ and $S_2$ separately proved optimum for most parameters. While combination $B_{P30} \times S_1$ proved optimum for most parameters. $B_{P30} \times S_1$ enhanced seed yield and seed protein content by 31.05% and 18.27% respectively, compared with $B_{P15} \times S_w$.

**Experiment 3:** The trial was conducted during 1985-86. Six doses of basal + foliar nitrogen, i.e., $B_{N15}+F_w, B_{N30}+F_w, B_{N15}+F_{N5}, B_{N30}+F_{N5}, B_{N15}+F_{N10}$ and $B_{N30}+F_{N10}$ (taking the optimal and sub-optimal basal dose of nitrogen determined in Experiment 1), were applied to plots given a uniform basal dose of 30 kg P and 30 kg K/ha. Seeds of lentil were soaked in 0.2 and 0.3% ($S_1$ and $S_2$) aqueous pyridoxine solution before sowing. The individual and combined effects of these treatments were studied on growth parameters, NRA and leaf NPK content at 120d, NAR for 90-120d interval and yield parameters and seed protein content at harvest. Of these, individual and combined effect of $B_{N15}+F_{N5}$ and $S_2$ proved optimum for almost all parameters, resulted in a saving of 10 kg N/ha as compared with Experiment 1. The interaction $(B_{N15}+F_{N5}) \times S_2$ increased seed yield by 21.04% and seed protein content by 6.35% over $(B_{N15}+F_w) \times S_1$. 

**Experiment 4:** The trial was conducted during 1985-86. Six doses of basal and foliar phosphorus, viz., $B_{P20}+F_w$, $B_{P30}+F_w$, $B_{P20}+F_{p1}$, $B_{P30}+F_{p1}$, $B_{P20}+F_p$ and $B_{P30}+F_p$ (taking the optimal and sub-optimal basal phosphorus dose determined in Experiment 2), were applied to plots given a uniform basal dose of 30 kg N and 30 kg K/ha. Seeds of lentil were soaked in 0.2% ($S_1$) and 0.3% ($S_2$) pyridoxine solution before sowing. The individual and combined effects of these treatments were studied on growth parameters, NRA and leaf NPK content at 120d, NAR for 90-120d interval and yield parameters and seed protein content at harvest. Among different levels of phosphorus (basal + foliar) and soaking treatments, $B_{P20}+F_p$, and $S_2$, alone as well as in combination, proved optimum for all parameters, resulted in a net saving of 8 kg P/ha as compared with the optimum dose determined in Experiment 2. The combination ($B_{P20}+F_p$) x $S_2$ resulted in an increase of 24.13% and 16.36% in seed yield and seed protein content respectively over ($B_{P20}+F_w$) x $S_1$.

**Experiment 5:** The experiment was conducted during 1985. Four doses of nitrogen, i.e., no nitrogen ($B_{N0}$), 5 kg N/ha ($B_{N5}$), 10 kg N/ha ($B_{N10}$) and 15 kg N/ha ($B_{N15}$), were applied to plots given a uniform basally applied 30 kg P and 35 kg K/ha. Seeds of moong were soaked in 0.0% ($S_w$), 0.2% ($S_1$), 0.3% ($S_2$) and 0.4% ($S_3$) pyridoxine solution before sowing. The individual and combined effects of these treatments were studied on growth parameters, NRA and leaf NPK content at 20, 30, 40 and 50d; NAR for 20-30, 30-40d and 40-50d intervals and yield parameters and seed protein content at harvest. Of these, $B_{N5}$ and $S_2$ proved optimum for almost all parameters. Among different interactions, $B_{N5}$ x $S_1$ proved optimum for most of the parameters. This interaction resulted in an increase of 31.72% and 7.86% in seed yield and seed protein content respectively over $B_{N0}$ x $S_w$. 
Experiment 6: The effect of basally applied phosphorus, viz., $B_{P15}$, $B_{P30}$, $B_{P45}$ and $B_{P60}$ and pre-sowing seed treatments with aqueous pyridoxine solution, i.e., 0.0% ($S_0$), 0.2% ($S_1$), 0.3% ($S_2$) and 0.4% ($S_3$) alone and in combination, was studied in the presence of 10 kg N and 35 kg K/ha applied uniformly at the time of sowing, on growth parameters, NRA and leaf NPK content at 20, 30, 40 and 50d; NAR for 20-30d, 30-40d and 40-50d intervals and yield parameters and seed protein content at harvest in 1985. Among these, $B_{P15}$ and $S_2$ separately proved optimum for all parameters, while $B_{P15} \times S_2$ emerged as the best combination for all parameters. The interaction, $B_{P15} \times S_2$ enhanced the seed yield and seed protein content by 31.06% and 11.75% respectively over $B_{P15} \times S_0$.

Experiment 7: The experiment was conducted during 1986. Five doses of basal + foliar nitrogen, i.e., $B_{N2.5} + F_{W}$, $B_{N5} + F_{W}$, $B_{N2.5} + F_{N1.25}$, $B_{N2.5} + F_{N2.5}$ and $B_{N2.5} + F_{N5}$ (taking the optimal and sub-optimal basal nitrogen dose determined in Experiment 5), were applied to plots given a uniform basal dose of 15 kg P and 35 kg K/ha. Seeds of moong were soaked in 0.2% ($S_1$) and 0.3% ($S_2$) aqueous pyridoxine solution before sowing. The individual and combined effects of these treatments were studied on growth parameters, NRA and leaf NPK content at 40 and 50d; NAP for 30-40 and 40-50d intervals, yield parameters and seed protein content at harvest. Of these, $B_{N2.5} + F_{N1.25}$ and $S_2$ alone and in combination proved optimum for all parameters studied. Although it resulted in a saving of only 1.25 kg/ha of nitrogen, it increased seed yield by 20.27% and seed protein content by 7.12% over $(B_{N2.5} + F_{W}) \times S_1$.

Experiment 8: The trial was conducted during 1986. Six doses of basal + foliar phosphorus, i.e., $B_{P10} + F_{W}$, $B_{P15} + F_{W}$, $B_{P10} + F_{P1}$, $B_{P15} + F_{P1}$, $B_{P10} + F_{P2}$ and $B_{P15} + F_{P2}$ (taking the optimal and sub-optimal basal phosphorus dose determined in Experiment 6), were applied to plots given a uniform basal dose of 5 kg N and 35 kg K/ha. Seeds of moong were soaked in 0.2% and 0.3%
(S₁ and S₂) pyridoxine solution before sowing. The individual and combined effects of these treatments were studied on growth parameters, NRA and leaf NPK content at 40 and 50d; NAR for 30-40 and 40-50d intervals, yield parameters and seed protein content at harvest. Treatments, B₁₀F₁₂ (equalled by B₁₅F₁₁) and S₂ proved best for most parameters separately. Among various combinations, (B₁₀F₁₂) x S₂ excelled all other interactions and proved optimum for all parameters, increasing seed yield and seed protein content by 35.66% 19.33% respectively over (B₁₀F₁₁) x S₁ with a saving of 18 kg P/ha as compared with the Experiment 6.

The information contained in this thesis is new addition to the literature on the growth, development and seed quality of grain legumes in particular and crop plants in general in the following respects:

1. The optimum requirement of nitrogenous and phosphatic fertilisers for lentil and summer moong (Experiment 1, 2, 5 and 6) for the agro-climate obtaining at Aligarh (Western Uttar Pradesh) was determined with precision.

2. The concentration of pre-sowing seed treatment with aqueous pyridoxine (vitamin B₆) solution for optimum performance of the two crops was repeatedly confirmed in all trials undertaken (Experiments 1-8).

3. The optimum combinations of nitrogenous or phosphatic fertilisers with soaking treatments were determined for the first time (Experiments 1-8).

4. In conclusion, comparison of all experiments reveals that supplemental foliar spray of nitrogen and phosphorus was effective and economical for both lentil and moong. Whereas, 0.3% aqueous pyridoxine solution as pre-sowing seed treatment has invariably pronounced stimulating effect on yield of both crops. Thus, pyridoxine treatment promotes "soil and
and leaf-applied nutrient use efficiency" in both crops. Therefore, minimum application of nutrients (nitrogen and phosphorus) in combination with 0.3% aqueous solution of pyridoxine treatment of seeds may be exploited economically to augment the yield and seed quality of lentil and summer moong.