Vegetable Science (2011) 38(1) : 117-118

Short communication

Effect of *Rhizobium* inoculation and phosphorus application on protein and carbohydrate content of cowpea [*Vigna unguiculata* (L.) walp]

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Received : Sep 2009 / Accepted : Dec 2010

Cowpea (*Vigna unguiculata* (L.) Walp) is an important legume crop with manifold uses. It is used as vegetable, pulse, green manuring and fodder crop in dry and semi-arid zones of the world. In human nutrition cowpea green pods as a vegetable and dry seeds as pulse occupy an important position due to its richness in protein, vitamins and minerals. it is an excellent vegetable for, human consumption and is generally grown for its immature pods and nature seeds. Besides the whole plant provides fodder for animals and adds nitrogen when ploughed into soil. Bio-fertilizer technology does not require any nonrenewable source of energy and this would be such to minimize our dependence on fertilizer nitrogen, as the abundant quantities of di-nitrogen can easily be tapped for agricultural purposes through a number of symbiotic bacteria called as *Rhizobium*. These bacteria take-up free nitrogen from the air and convert it into nitrogenous compounds for the use of crop plants. The bacteria grow and multiply inside the nodules. These bacteria obtain carbohydrate and mineral food from the plant and nitrogen from the air to form nitrogenous compounds e.g., proteins, which then become available to the host plant. Keeping in view the above fact the present study was undertaken to study the interaction effect of *Rhizobium* inoculation and phosphorus application on protein and carbohydrate content of cowpea.

The field experiment was carried out at Vegetable Research Farm and Laboratories of the Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during the years 2007 and 2008. The treatment consisted of five levels of phosphorus & two *Rhizobium* culture i.e. inoculated and un-inoculated seed. For treating the seeds the sticker solution was prepared by dissolving 2.5 g of sugar with 1.0 of Acacia in 1000 ml water, the solution was sterilized and maintained. Bacteria grown in broth and sticker solution was mixed together in a ratio 2:l .Phosphorus was applied @ 0, 25, 50, 75 and 100 kg/ha. Nitrogen and potash were applied @ 25 kg and 30 kg/ha respectively to all the plots. The protein content was estimated in pod along with seed in form of total nitrogen content and this value was multiplied by factor 6.25 (A.O.A.C. 1960) to know the crude protein. For the estimation of total carbohydrate in cowpea pods 10g dried sample was taken in Erelenmeyer flask to which sufficient amount of 10 % hydrochloric acid was added and neutralized after cooling by Adding sodium hydroxide solution. This was followed by the addition of saturated solution of lead acetate and was filtered in dry conical flank containing potassium or sodium oxalate. Again it was filtered in dry volumetric flank and volume was made up to the mark. Briskly sugar solution titrated against Fahling A + B. One ml of each of the fehling A + B was taken into a 250 ml flask to which little amount of distilled water was added. This was kept for heating and a boiling briskly sugar solution was added as an internal indicator and titrated as soon to the colour changed to brick-red colour the titration was completed.

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Print (29) - VS20090048

Table 1: Protein and carbohydrate content (%) as influenced by Rhizobium inoculation, phosphorus application and their interactions in cowpea

Treatments	Protein content		Carbohydrate content	
	2007	**2008**	**2007**	**2008**
Rhizobium culture				
Rh-	3.65	3.69	7.04	7.03
Rh_{+}	3.78	3.90	7.49	7.54
SEm±	**0.01**	**0.02**	**0.01**	**0.01**
C. D.	**0.02**	**0.06**	**0.03**	**0.02**
P_2O_5kg/ha				
P_0	3.37	3.34	6.65	6.74
P_{25}	3.57	3.60	7.10	7.03
P_{50}	3.74	3.82	7.41	7.38
P_{75}	3.86	4.08	7.48	7.53
P_{100}	4.04	4.14	7.69	7.71
SEm±	**0.01**	**0.03**	**0.02**	**0.01**
C.D.	**0.04**	**0.09**	**0.04**	**0.04**
Rh-P_0	3.31	3.34	6.39	6.47
Rh-P_{25}	3.56	3.53	6.88	6.76
Rh-P_{50}	3.65	3.77	7.20	7.16
Rh-P_{75}	3.79	3.86	7.22	7.34
Rh-P_{100}	3.96	3.96	7.50	7.42
Rh+P_0	3.44	3.35	6.90	7.00
Rh+P_{25}	3.59	3.67	7.33	7.38
Rh+P_{50}	3.82	3.88	7.61	7.61
Rh+P_{75}	3.93	4.30	7.74	7.73
Rh+P_{100}	4.12	4.31	7.88	8.00
SEm±	0.02	0.04	0.02	0.02
C.D.	0.06	0.12	0.06	0.05

The values recorded on protein content of pods as influenced by the *Rhizobium* inoculation and phosphorus application individually and in combined form are presented in Table. *Rhizobium* inoculation exerted a significant improvement on protein content of pod during both the years of study. The maximum protein content in pods, i.e. 3.78% and 3.90% were obtained under *Rhizobium* inoculated plants, The highest protein content was found with *Rhizobium* inoculation + 20 kg N/ha reported by Mishra *et al.* (2001).The minimum protein content in pods i.e. 3. 65% and 3.69% were determined under control during 2007 and 2008 respectively. Protein content of seed was also influenced by *Rhizobium*, nitrogen and phosphorus reported by Singh *et al.* (2007). Application of different doses of phosphorus proved to be significantly beneficial during both the years of experimentation. The highest protein, i.e. 4.04% and 4.14% were determined under highest dose of phosphorus application, while the minimum values, i.e. 3.37% and 3.34% were obtained under control in two years, respectively. However, it was observed that the treatments P_{75} and P_{100} were at par during 2008. All the treatments combinations exhibited significant influence on protein content of edible pods during both the years of study. The maximum protein content, i.e. 4.12% and 4.31% were recorded under 100kg/ha phosphorus application, while the minimum, i.e. 3.31% and 3.34% were noted under control during 2007 and 2008 respectively. It was also noted that the values observed under Rh-P_{50} and Rh-P_{75}, and Rh-P_{100}, Rh+P_{75} and Rh+P_{100} were at par in 2008.

It is obvious from the results in respect of carbohydrate content that *Rhizobium* inoculation brought significant increase during both the years of study. The maximum carbohydrate content, i.e. 7.49% and 7.54% were noted from Rh+ treatment, while minimum carbohydrate content, i.e. 7.04% and 7.03% were obtained from Rh- (control) during 2007 and 2008 respectively. Increasing levels of phosphorus brought significant increased in respect of carbohydrate content of pod during both the years of experimentation. The highest values, i.e. 7.69% and 7.71% were determined under highest level of phosphorus application; however the minimum values i.e. 6.65% and 6.74% were recorded in two respective years. There were increases in the alpha -amino-N concentrations with increasing phosphorus concentration. In nodules, TRS concentration was not affected by increasing Phosphorus. Increasing Pc up to P6 concomitantly decreased the starch concentration in leaves but not in roots of R+ and N+ plants reported by Izaguirre *et al.* (2002). Interactions of *Rhizobium* and phosphorus proved to be significantly beneficial for carbohydrates content during both the years. The maximum values, i.e. 7.88 and 8.00% and minimum values, i.e. 6.39% and 6.47% were observed under Rh+P_{100} and Rh-P_0 (control) during both the years respectively. It was also observed that the values recorded under Rh-P_{50} were at par with Rh-P_{75} in 2007.

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