Indian Journal of Agronomy **58** (4): 618–621 (December 2013)

Research Communication

Growth and yield of greengram (*Vigna radiata*) under foliar application of *panchgavya* and leaf extracts of endemic plants

PRAKASH YADAV[1] AND A.K. TRIPATHI[2]

Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208 002

Received : April 2013; Revised accepted : October 2013

ABSTRACT

An experiment was conducted during the rainy (*kharif*) season of 2011, under irrigated condition, at Kanpur, Uttar Pradesh to study the effect of foliar applied *panchgavya* with and without mixing leaf extracts of neem (*Azadirachta indica* A. Juss.) and parthenium (*Parthenium hysterophorus* L.) in 1:1 ratio on the growth, yield and economics of greengram [*Vigna radiata* (L.) Wilczek]. Foliar application of *panchgavya* + neem-leaf extracts (NLE) significantly increased dry-matter accumulation, physiological growth and yield attributes as well as yield of greengram compared to water-sprayed control and sole application of *panchgavya*. Application of *panchgavya* + NLE recorded higher grain (27.7 and 10.5%) and straw yield (14.4 and 10.3%) as well as net returns (36.3 and 16%) compared with the control and sole *panchgavya* respectively. Application of the foliar sources at 3 times (branching, pre-flowering and pod-setting stages) recorded significantly higher dry matter, growth and yield attributes, yield and net return over single or in combination of two or four.

Key words **:** Crop production, Foliar application, Greengram, Leaf extracts, Organic farming, *Panchgavya*

Greengram is cultivated on an area of 3.44 million hectares with total grain production of 1.20 million tonnes and average yield of 351 kg/ha during 2010 which contributed 14.79% in area and 8.50% in production of total pulses in India (IIPR, 2011). Majority of Indian farmers who are mostly marginal and small, are unable to apply the recommended dose of fertilizers due to its prohibitive cost and unavailability. They are using indigenous organic manures as sources of nutrients. Therefore, it is essential to develop a strong workable and compatible package of nutrient management through organic resources for various crops based on scientific facts, local conditions and economic viability. In this context, it is worth noting that nutrient management through organics plays a major role in maintaining soil health due to build up of soil organic matter, beneficial microbes, enzymes, besides improving soil physical and chemical properties. To achieve soil fertility and crop productivity in a sustainable manner, the role of organic manures and other nutrient management practices like use of fermented liquid organic fertilizers, viz. *Panchagavya, Jeevamrut, Beejamrut, Sasyamrut, Gomutra, Angara, Vermiwash* etc, are very vital. These fermented liquid organic fertilizers have in addition to nutrients, microbial load/count and plant growth promoting substances (PGPR) which help in stimulating plant growth, yield, metabolic activity and resistance to pest and diseases.

Role of *panchgavya* in sustainable production of many arable crops has been well documented in India. There are reports indicated that efficacy of *panchgavya* with the blending of endemic plant leaves enhanced manifold in growth and production (Selvaraj, 2006). In the study area, plants like neem (*Azadirachta indica* A. Juss.) and parthenium (*Parthenium hysterophorus* L.) grow abundantly producing lot of biomass of less value. However, information on use of *panchgavya* mixing with leaf extracts of endemic plants on greengram is very meager. Therefore, an experiment was carried out with foliar applied *panchgavya* in association with leaf extracts of endemic plants on growth and yield of greengram.

A field experiment was conducted at Students' Instructional Farm of the University at Kanpur (Uttar Pradesh) during the rainy (*kharif*) season of 2011 under irrigated conditions. The soil was sandy clay loam, having 0.21% organic carbon, 220 kg/ha available N, 16 kg/ha available P, 235 kg/ha available K with pH 8.3. The experiment was laid out in factorial randomized block design with 3 replications. Twenty-two treatment combinations comprised

Based on part of M.Sc. thesis of the first author submitted CSAUA&T, Kanpur during 2012 (Unpublished)

[2]Corresponding author Email: aktripathiak@gmail.com
[1]M.Sc. Student; [2]Assistant Professor, Department of Agronomy

3 sources of foliar application and 7 stages of application along with absolute water-sprayed control (Table 1). The leaf-extract of two commonly available plants, i.e. neem (*Azadirachta indica*) and parthenium (*Parthenium hysterophorus*) along with *panchgavya* and control (water spray) were used as sources of foliar application. *Panchgavya* solution was prepared by thorough mixing of fresh cowdung (1.0 kg), cow *ghee* (0.1 kg), fresh cow urine (1.2 l), cow milk (0.4 l), cow curd (0.4 l), jaggery (0.1 kg dissolved in 0.6 l water), tender coconut water (0.6 l), ripe banana (3) and yeast powder plus jaggery (20 g + 20 g mixed in 400 ml of warm water). *Panchgavya* was ready for use after a period of 18 days. The leaf extracts of neem and parthenium were prepared by mixing grounded fresh leaves with cow urine in 1:1 ratio, followed by fermentation for 7 days in open plastic bucket. The filtrates of both plant leaf extracts were mixed with the filtered *panchgavya* solution in the ratio 1:1 to prepare the foliar solutions of respective plants. Twenty litres of filtered solution each of *panchgavya* and plant leaf extracts per hectare @ 3% was used for a single application.

Greengram 'IPM 2-3' was sown on 1 August 2011 @ 15 kg seed/ha. The seeds were treated with *Rhizobium* culture (1 packet for 10 kg seed) as prophylactic measures against seed-borne diseases. Sowing was done in rows, spaced at 40 cm apart. Thinning of extra plants was done at 15 days after sowing to maintain plant-to-plant distance of 15 cm. Application of *panchgavya* and plant-leaf extracts on the crop foliage were done as per the treatments. Crop-growth rate (CGR) was calculated as per Gardner *et al*. (1995).

Foliar applied *panchgavya* and plant-leaf extracts had significant effect on growth parameters of greengram (Table 1). Application of *panchgavya* + neem leaf extracts (NLE) attained significantly higher plant height (41.01 cm) and increased dry matter by 67.7% over water-sprayed control. Similarly, as compared to control, *panchgavya* + NLE enhanced number of root nodules/plant by 48.7% and root nodule dry weight/plant by 91.2%. The physiological growth in terms of CGR recorded increasing trend with progress in crop growth from 35 days after sowing to harvest. The frequency of foliar sources had considerable effect on, nodulation/plant and all the growth parameters at all observed stages (Table 1). Three foliar applications of different sources at branching (B) + pre-flowering (PF) + pod setting (PE) recorded higher values of these parameters over single and dual application but found on a par with that of 4 applications at B + PF + PS + PM (pod maturation) in all cases. The significant improvement in dry matter was ascribed to in-

Table 1. Effect of foliar applied sources and their application at different stages on growth and development of greengram

Treatment	Plant height (cm)	DMA at harvest (g/plant)	Crop-growth rate (g/m²/day)		Nodulation/plant a 45 DAS		Branches/plant
			35–55 DAS	55 DAS–harvest	Root nodules/plant	Dry root nodules weight/plant (mg)	
Foliar source							
Panchagavya	39.2	18.2	5.3	6.8	23.9	15.1	4.18
Panchagavya + NLE	41.0	21.8	7.3	7.8	27.3	19.7	4.42
Panchagavya + PLE	39.4	19.5	6.5	6.8	25.1	16.9	4.27
SEm±	0.6	0.3	0.1	0.1	0.5	0.3	0.07
CD (P=0.05)	1.3	0.7	0.3	0.3	0.9	0.7	0.13
Stages of foliar spray							
Branching (B)	38.3	19.6	6.2	6.8	25.7	16.8	3.67
Pre-flowering (PF)	39.5	18.6	6.4	6.5	23.3	14.7	3.94
Pod setting (PS)	38.8	19.1	5.4	8.0	18.4	10.8	3.84
Pod maturation (PM)	37.1	18.2	4.4	8.2	18.3	11.1	3.65
B + PF	40.8	20.6	7.3	6.6	30.7	22.4	4.79
B + PF + PS	42.7	21.1	7.6	6.7	30.7	22.4	4.95
B + PF + PS + PM	42.8	21.5	7.5	7.1	30.7	22.4	5.09
SEm±	1.0	0.5	0.2	0.2	0.7	0.5	0.10
CD (P=0.05)	1.9	1.1	0.5	0.4	1.4	1.0	0.21
Control vs treatment							
Control (Water spray)	31.1	13.0	4.4	3.8	18.3	10.3	3.32
SEm±	0.87	0.5	0.2	0.3	0.6	0.5	0.09
CD (P=0.05)	1.75	1.0	0.4	0.6	1.3	0.9	0.18

NLE, Neem-leaf extract; PLE, *Parthenium* leaf extract; DAS, days after sowing; DMA, Dry-matter accumulation

creased supply of plant nutrients and more root nodules with the application of *panchgavya*-based foliar sources. Improved nutrition present in foliar sources might be facilitated greater leaf area production that resulted in larger interception of light thereby improving dry-matter productivity in clusterbean (Kumawat *et al*., 2011). Apart from nutrient supply, *panchgavya* contains proven biofertilizers, such as *Azospirillum*, *Azotobacter*, *Phosphobacter*, *Pseudomonas* that played important role in stimulation of plant growth by secreting IAA and GA_3 (Mahalingam and Sheela, 2003). Higher weight of nodules with foliar sources was attributed to increased crop growth and translocation of more carbohydrates towards developing root nodules. Increased allocation of food materials to roots in turn enhances the root volume and thereby weight of nodules increased concomitantly (Poorter and Nagel, 2000).

Yield attributes, viz. pods/plant, seeds/pod, grains/plant, grain weight/plant and 1,000-seed weight, and yield recorded significantly highest values with foliar applied *panchgavya* + NLE (Table 2). Application of *panchgavya* + NLE increased pods/plant by 45.6%, seeds/pod by 20.9%, grains/plant by 78.3%, grain weight/plant by 30.7% and 1,000-seed weight by 27.5% over water-sprayed control (Table 2). Compared to the control, grain yield increased to the tune of 27.7%, while straw yield by 21.7% more with *panchgavya* + NLE. Results further revealed that yield attributes and yields were recorded significantly higher with 3 application of foliar sources at B + PF + PS being at par with four applications (B + PF + PS + PM) over dual (B + PF) and single application either at irrespective stages. The application of these sources at either of single application alone may not supply nutrients in sufficient amount required for full development of the plants. Hence dual and triple application of these foliar sources recorded higher plant dry matter/plant and yields in the trial. Grain and straw yields recorded 19.8 and 15.7% increase with B + PF + PS over spray at single and 10.9 and 7.6% increase over at dual application (B + PF) respectively. Kumawat *et al*. (2009) also reported significant improvement in dry matter, crop growth, chlorophyll content, nitrate reductase activity and root nodule weight of the plant that lead to increased yield and yield attributes in groundnut. Since dry matter accumulation/plant had shown consistent increase with these sources of application in this study also. Thus, the increased dry matter contributed for higher yield attributes compared to the control. Kumawat *et al*. (2011) also observed similar results in clusterbean with application of *panchgavya* + neem leaf extract. Similarly, Oparaeke *et al*. (2001) reported that application of neem leaf extract increased pod intensity/plant in cowpea.

Panchgavya + leaf extracts and *panchgavya* alone increased gross and net returns as well as benefit: cost ratio compared to the control, being significantly the highest

Table 2. Effect of foliar applied sources and their application at different stages on yield attributes, yield and economics of greengram

Treatment	Pods/ plant	Seeds/ pod	Grains/ plant	Grain weight/ plant (g)	1,000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Gross returns (×10³ ₹/ha)	Net returns (×10³ ₹/ha)	Benefit: cost ratio
Foliar source										
Panchagavya	14.23	7.8	113.1	4.53	35.9	0.76	1.73	32.1	18.17	2.30
Panchagavya + NLE	15.59	8.3	131.5	5.02	40.9	0.84	1.91	35.5	21.08	2.47
Panchagavya + PLE	14.81	8.0	119.6	4.62	37.6	0.78	1.76	32.8	18.44	2.28
SEm±	0.32	0.1	2.8	0.07	0.5	0.012	0.022	0.6	0.35	0.03
CD (P=0.05)	0.65	0.2	2.6	0.14	0.9	0.025	0.045	1.1	0.71	0.06
Stages of foliar spray										
Branching (B)	12.67	7.3	92.6	4.36	34.9	0.74	1.67	31.1	17.74	2.33
Pre-flowering (PF)	14.05	7.8	109.3	4.52	37.3	0.77	1.71	32.3	18.94	2.41
Pod setting (PS)	13.42	7.5	100.7	4.44	35.8	0.75	1.68	31.5	18.16	2.36
Pod maturation (PM)	12.05	7.0	84.4	4.28	33.7	0.72	1.65	30.2	16.87	2.66
B + PF	16.18	8.7	143.0	4.97	39.8	0.80	1.81	33.7	19.38	2.34
B + PF + PS	17.49	9.0	157.0	5.21	42.1	0.89	1.99	37.4	22.03	2.42
B + PF + PS + PM	17.98	9.2	162.8	5.29	43.1	0.90	1.98	38.0	21.51	2.31
SEm±	0.49	0.2	4.2	0.11	0.7	0.019	0.34	0.8	0.53	0.05
CD (P=0.05)	0.99	0.4	8.5	0.21	1.4	0.039	0.69	1.7	1.08	0.09
Control vs treatment										
Control (water spray)	10.71	6.9	73.9	3.84	32.1	0.66	1.57	27.8	15.46	2.26
SEm±	0.45	0.2	3.8	0.10	0.6	0.017	0.031	0.8	0.48	0.04
CD (P=0.05)	0.90	0.3	7.7	0.19	1.3	0.035	0.063	1.6	0.99	0.09

NLE, Neem-leaf extract; PLE, *Parthenium*-leaf extract

gross return and net return and benefit: cost ratio recorded with the *panchgavya* + NLE (Table 2). The increase in net return and benefit: cost ratio with *panchgavya* + NLE could be attributed to higher grain yield of greengram. Similarly, application of foliar sources at B + PF + PS (3 foliar sprays) being on par with 4 foliar sprays (B + PF + PS +PM) resulted in significantly higher gross and net returns over application at 2 foliar sprays (B + PF) or single foliar spray at either of irrespective stages. Increased net returns and benefit: cost ratio with 2 foliar application of *panchgavya* + NLE at branching and flowering was reported by Kumawat *et al*. (2009) in groundnut**.**

It could be concluded that 3 foliar sprays of *panchgavya* along with neem-leaf extract at branching, pre-flowering and pod setting is advantageous in increasing physiological growth, dry-matter accumulation, yield attributes, yield and economics of greengram.

REFERENCES

Gardner, F.P., Pearce, R.B. and Mitchell, R.L. 1995. *Physiology of Crop Plants*. Iowa State University Press, Iowa, USA.

IIPR. 2011. *IIPR Vision 2030.* Indian Institute of Pulses Research, Kanpur, pp. 4, 14.

Kumawat, R.N., Mahajan, S.S. and Mertia, R.S. 2009. Growth and development of groundnut (*Arachis hypogaea*) under foliar application of *panchgavya* and leaf extracts of endemic plants. *Indian Journal of Agronomy* **54**(3): 324–31.

Kumawat, R.N., Mahajan, S.S. and Mertia, R.S. 2011. Growth and yield of clusterbean (*Cyamopsis tetragonoloba*) grown on light-textured soils with foliar application of fermented *panchgavya*. *Indian Journal of Agricultural Sciences* **81**(3): 230–35.

Mahalingam, P.U. and Sheela, S. 2003. Production of plant growth regulators by *Pseudomonas aeruginsa*. (In) *Abstracts, UGC Sponsored State Level Seminar on Indigenization of Indian Farming: Problems and Prospects,* held during 7–8 March 2003 at Gandhigram Rural Institute, Deemed University Gandhigram, Tamil Nadu, India, pp. 1–25.

Oparaeke, A.M., Dike, M.C. and Amatobi, C.I. 2001. Botanical pesticide mixtures for insect pest management on cowpea (*Vigna unguiculata* L). *Journal of Sustainable Agriculture* **29**: 5–13.

Poorter, H. and Nagel, O. 2000. The role of biomass allocation in the growth response of plants to different levels of light, CO_2, nutrients and water: a quantitative review. *Australian Journal of Plant Physiology* **27**: 595–07.

Selvaraj, N. 2006. *Dasagavya: Organic Growth Promoter for Plants,* p. 18. *The Hindu*, New Delhi.