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Effect of fertility levels and bioinoculants on growth, productivity and economics of cluster bean (*Cyamopsis tetragonoloba*)

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Cluster bean (*Cyamopsis tetragonoloba* L.) is a drought hardy legume crop of *kharif* season in arid and semi-arid regions of tropical India. Traditionally it is grown for feed, fodder and vegetable purposes. Owing to its short duration nature, it may act as an important component of cropping systems of the region. Cluster bean of late, has acquired the status of industrial crop because of high glactomanan content in the endosperm of its seed, which has multiple industrial uses and thus a main foreign-exchange earner for the area. Despite of the maximum area of Cluster bean in Rajasthan, the average productivity is only 0.25 tonne/ha as compared to 0.37, 0.70 and 1.20 tonnes/ha in Gujarat, Haryana and Punjab, respectively (Henry 2003). Improper nutrient management under limited moisture condition is considered as major limiting factors for achieving higher productivity of cluster bean in arid and semi-arid region. The nutrient management thus assumes importance to sustain its productivity. Due to poor socio-economic conditions of farmers coupled with low and erratic rainfall distribution, the intensive use of chemical fertilizers is a risky proposition for these regions.

By and large bio-fertilization is one of the alternatives to increase soil fertility in arid and semi arid region. *Rhizobium* plays an important role in agriculture by inducing nitrogen fixing nodules on the roots of legumes. Nitrogen fixation is one of most important biological processes on earth (Graham 2008) and *Rhizobium* inoculation of legumes is one of the success stories of world agriculture. Addition of nitrogen through the process of nitrogen fixation is cheap to the farmer, without any hazards, avoiding the use of chemical fertilizer. So such type of nutrient supplementation through bioinoculants as integrated nutrient supply system may be a better option to fulfill nutrient requirement of the crop. Keeping this in view, the present study was undertaken to assess the impact of fertility levels and bioinoculants on the growth, yield and economics of cluster bean.

The field experiment was conducted during rainy (*kharif*) season of 2008 at SKN College of Agriculture, Jobner, Rajasthan. The soils of experimental field was loamy sand in texture, having very low organic carbon (0.13%), available N (130.2 kg/ha), medium in available phosphorus (16.5 kg/ha) and low in available potassium (151.9 kg/ha). The pH of soil is alkaline in reaction (pH 8.1). The experiment was laid out in randomized block design with three replications. The experiment consisted of 10 nutrient-management treatments, viz. Control, PSB, 50%, 75%, 100% recommended dose of fertilizer (RDF), 50% RDF + *Rhizobium*, 50% RDF+PSB, 75% RDF + *Rhizobium* and 75% RDF + PSB. The Cluster bean variety RGC 936 was sown with hand operated 'desi' plough with 'pora' attachment at 30 cm rows on 17 July 2008. Cluster bean was grown as per the recommended package of practices and harvested on 10 November 2008. The net plot size was 4.0 m × 3.0 m. The recommended dose of fertilizer (RDF) was 20 kg N + 40.0 kg P_2O_5/ha, applied as basal through urea and single superphosphate as per treatment. Bioinoculants (*Rhizobium* and PSB) was applied as seed treatment just before sowing. Five random plants were selected from each plot, excluding the border row, for taking observations on growth and yield attributes. Economic analysis of the data was done based on the prevailing cost of inputs/operations and price of the marketable produce. The data collected from the experiment were statistically analyses by analysis of variance techniques (Panse and Sukhatme 1985).

Among the treatment combinations, application of 75% RDF+*Rhizobium* recorded the maximum plant height, branches/plant, plant dry weight/metre row length and nodules/plant over PSB and control, however, it remained statistically at par with *Rhizobium*, 50% RDF, 75% RDF, 100% RDF, 50% RDF+*Rhizobium*, 50% RDF+PSB and

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75% RDF+PSB (Table 1). The reasons for better growth and development under these treatments may be increased availability of nutrients to plant initially through chemical fertilizers and laterally by bioinoculants. As nitrogen is involved in photosynthesis, which results in increased vegetative growth while, phosphorus encourages the formation of new cells, promotes plant vigour and root growth, hastens leaf development which helps in harvesting more solar energy and later utilization of nitrogen which can be attributed for higher plant height and branches/plant. Nitrogen accelerates photosynthetic rate and thereby increases the supply of carbohydrate to plant which have resulted in increased dry matter accumulation. Phosphorus is a main constituent of energy rich phosphate molecules, viz. ATP, influences photosynthesis, biosynthesis of proteins and phospholipids, nucleic acid synthesis, cytoplasmic streaming and membrane transport. Phosphorus not only plays an important role in root development and proliferation but also improves nodulation and nitrogen fixation by supplying assimilates to the roots and enhanced nodulation under influence of applied phosphorus resulted in greater nitrogen fixation in soil and thereby increased its availability to the plants. It is obvious that PSB produces organic acids which render the insoluble phosphate to soluble one (Stevenson 1967). Thus availability of native and applied phosphorus increased in root zone for utilization by the plant for growth and nodulation. These results corroborate with the findings of Singh *et al*. (1983).

Highest yield attributes, i e pods/plant, seeds/pod and 1000-seed weight were also recorded with application of 75% RDF+*Rhizobium* which was significantly higher over PSB and control but remained statistically at par with *Rhizobium*, 50% RDF, 75% RDF, 100% RDF, 50% RDF+*Rhizobium*, 50% RDF+PSB and 75% RDF+PSB (Table 1). In general, the significant improvement in yield attributes of Cluster bean due to nitrogen and phosphorus fertilization combined with bioinoculants could be ascribed to overall improvement in vigour and crop growth. Similarly seed yield (1103 kg/ha) and stover yield (2986 kg/ha) were also maximum with 75% RDF+*Rhizobium* and this treatment was significantly superior over PSB and control but statistically at par with *Rhizobium*, 50% RDF, 75% RDF, 100% RDF, 50% RDF+*Rhizobium*, 50% RDF+PSB and 75% RDF+PSB (Table 1). The significant increase in biological yield with the application of nitrogen and phosphorus could be ascribed to increased seed and straw yields. The results of present investigation are in conformity with those of Rajput and Singh (1996), Gandhi *et al*. (1991) and Mishra and Baboo (2002). This might be due to fact that *Rhizobium* inoculation increased the root volume through better root development, nodulation, more nutrient availability resulting in vigorous plant growth and dry matter production which in turn resulted in better flowering, pod formation and ultimately seed yield. Since, PSB may helps in reducing phosphorus fixation by its chelating effect and also solubilized the fixed phosphorus leading to more uptakes of nutrients and reflected in better yield attributes.

Table 1 Effect of fertility levels and bioinoculants on growth, productivity and economics of cluster bean

Treatment	Plant height (cm)	Branches/ plant	Dry weight/ metre row length (g)	Nodules/ plant	Pods/ plant	Seeds/ pod	1000-seed weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Gross returns (× 10³ ₹/ha)	Net returns (× 10³ ₹/ha)	B:C ratio
Control	88.2	11.7	68.0	13.1	22.8	4.5	26.5	676	2087	24.46	15.61	5.71	0.58
Rhizobium	110.8	13.0	74.0	15.9	28.6	5.4	30.0	839	2425	25.70	19.21	9.26	0.93
PSB	99.1	12.8	73.4	16.2	28.3	5.2	30.2	886	2403	26.94	20.12	10.17	1.02
50% RDF	111.3	13.0	80.7	15.0	31.0	5.6	30.7	907	2507	26.56	20.65	9.50	0.85
75% RDF	116.3	15.2	82.3	15.7	32.1	6.0	30.9	978	2617	27.20	22.18	11.03	0.99
100% RDF	124.2	16.1	89.0	17.0	34.5	6.9	34.3	1074	2912	26.94	24.39	12.80	1.10
50% RDF + *Rhizobium*	113.0	14.7	82.2	18.3	32.3	6.2	33.0	960	2767	25.76	21.97	10.77	0.96
50% RDF + PSB	116.5	14.9	82.6	17.8	31.8	6.0	32.8	983	2809	25.92	22.47	11.27	1.01
75% RDF + *Rhizobium*	125.9	18.5	94.3	21.5	37.4	7.8	35.4	1103	2986	26.97	25.05	13.63	1.19
75% RDF + PSB	122.7	17.0	90.5	20.4	35.9	7.1	34.2	1062	2902	26.79	24.14	12.72	1.11
SEm±	6.96	0.90	5.02	0.98	1.93	0.38	1.94	59.14	162.80	1.57	1.35	0.68	0.06
LSD (P=0.05)	20.68	2.67	14.92	2.91	5.72	1.13	5.76	175.72	483.70	NS	4.0	2.03	0.18

The synergistic effect of *Rhizobium* and PSB might be increases the yield attributes and yield. With regards to economics, maximum gross returns (25.05 × 10^3 ₹/ha), net returns (13.63 × 10^3 ₹/ha) and B:C ratio (1.19) were recorded with 75 % RDF+*Rhizobium* followed by 100% RDF. This was due to the fact that the treatment registered maximum economic yields and ultimately fetches higher market prices.

SUMMARY

A field experiment was conducted at research farm of SKN College of Agriculture, Jobner, Rajasthan to assess the effect of fertility and bioinoculants on growth, yield and economics of cluster bean (*Cyamopsis tetragonoloba* L.). The results revealed that application of 75% recommended dose of fertilizer along with *Rhizobium* inoculation recorded higher growth (plant height, branches/ plant, dry matter accumulation/plant and nodules/plant); yield attributes (pods/plant, seeds/pod and 1000-seed weight) seed and stover yields, gross returns (25.05 × 10^3 ₹/ha), net returns (13.63 × 10^3 ₹/ha) and B:C ratio (1.19) as compared to control and phosphate solubilizing bacteria (PSB) inoculation and remained at par with all other treatment combination. So, it was concluded that use of 75% RDF along with *Rhizobium* may be recommended for obtaining the higher yield of Cluster bean in the region.

REFERENCES

Gandhi D V, Wagh R G and Thorat S T. 1991. Effect of sowing times and fertilization on the yield and quality of cowpea. *Agriculture Science Digest* **11**: 178–80.

Graham P H. 2008. Ecological of the root-nodule bacteria of legumes. (*In*) *Nitrogen-Fixing Leguminous Symbioses. Nitrogen Fixation: Orgins, Application,* Volume 7, Dilworth M J, James E K, Sprent J I and Newton W E (Eds). Sprinker, pp 23–43.

Henry A. 2003. Cluster bean: an industrial crop for arid zone. (*In*) *Human Impact on Desert Environment*, pp. 287–93. Narain Pratap, Kathju S, Kar Amal, Singh M P and Parveen Kumar (Eds). Arid Zone Research Association of India, Scientific Publishers, Jodhpur.

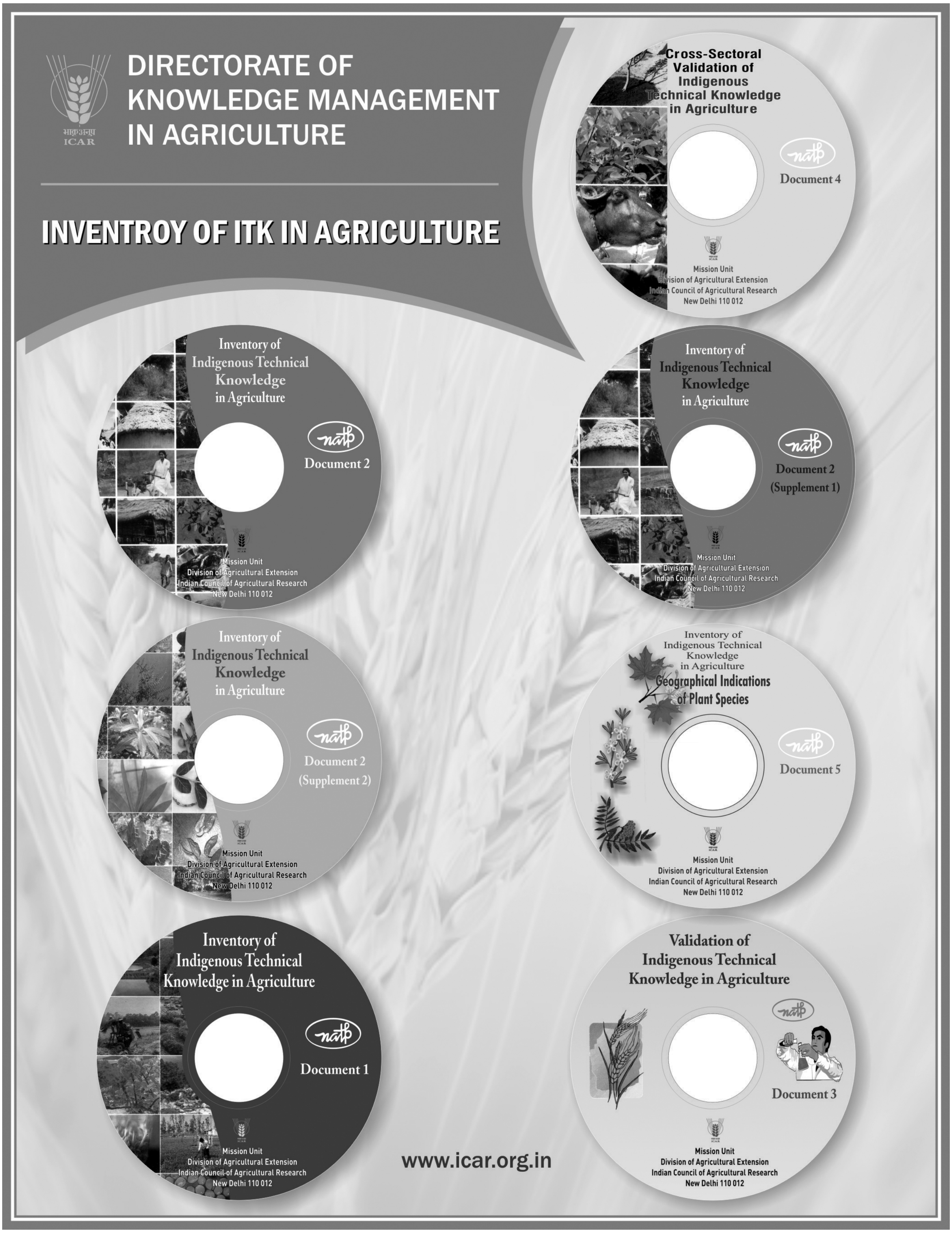
Mishra S K and Baboo R. 2002. Effect of nitrogen and phosphorus level on the yield and quality of cowpea. *Annals of Agricultural Research* **23**(3): 387–90.

Panse V G and Sukhatme P V. 1985. *Statistical Methods for Agricultural Workers*. Indian Council of Agricultural Research, New Delhi.

Rajput A L and Singh T P. 1996. Response of nitrogen and phosphorus with and without *Rhizobium* inoculation on fodder production and cowpea (*Vigna unguiculata*). *Indian Journal of Agronomy* **41**: 91–4.

Singh M, Singh J and Singh K. 1983. Effect of phosphorus and bioinoculants on chlorophyll content of leaves and leghaemoglobin content of fresh nodules in *kharif* grain legumes. *Indian Journal of Agronomy* **28**(3): 229–34.

Stevenson F J. 1967. *Cycles of Soil*, p 380. John Wiley & Sons, New York, USA.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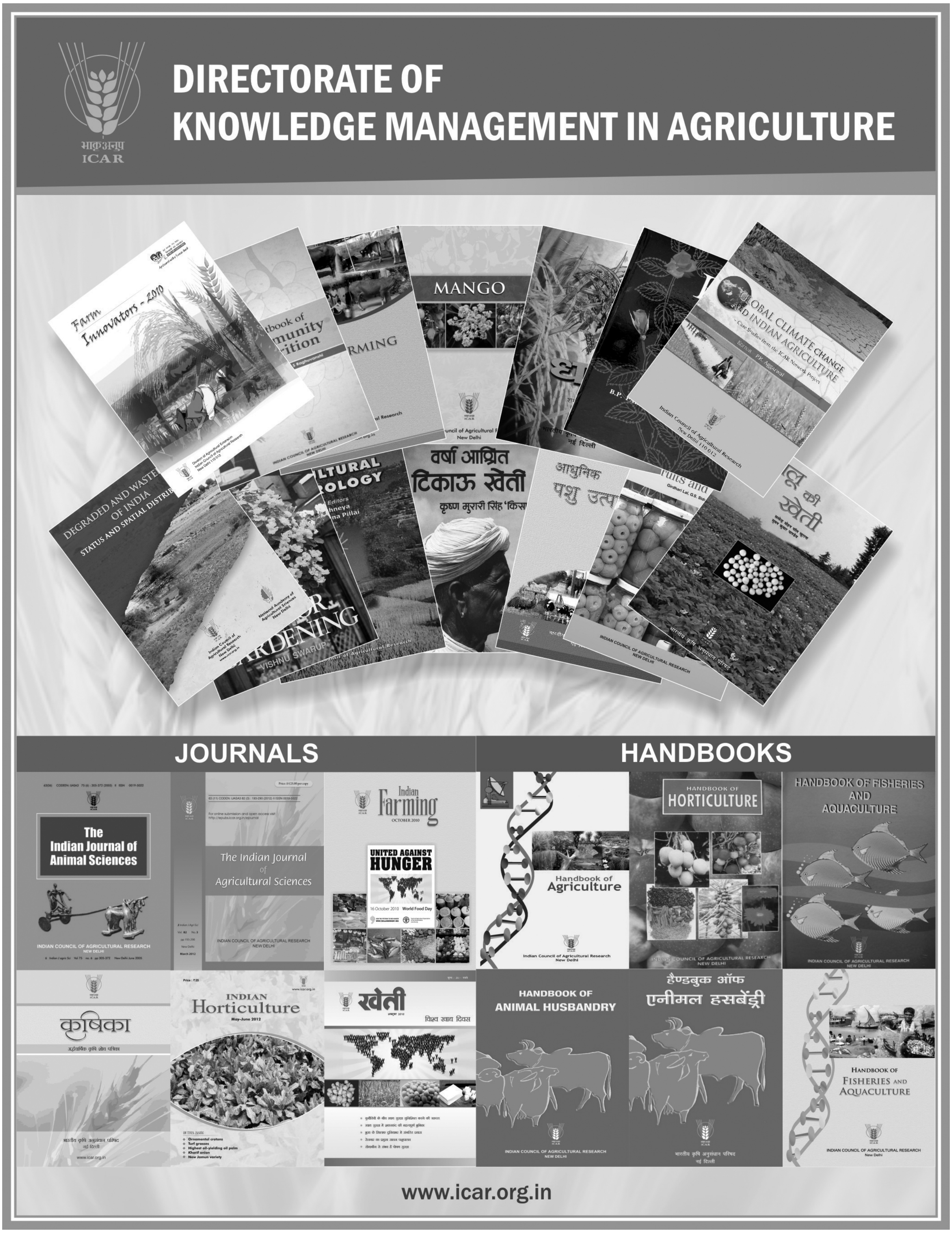
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