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Site specific evaluation of pigeon pea (*Cajanus cajan*) variety IPA 203 through participatory approach

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ABSTRACT

A site-specific evaluation of pigeon pea (*Cajanus cajan* (L.) Millsp.) variety IPA 203 was carried out through farmers participatory approach during two consecutive years, i.e. 2018–19 to 2019–20. The results revealed that the average yield 15.40 q/ha was recorded from pigeon pea variety IPA 203 as compared to farmers practice 9.79 q/ha and an average yield advantage registered up to 57.30% higher over the farmers' practice. It was also observed that the higher number of primary branches/plant (6), number of pods/plant (385), seed index (14.80 g/100 seed), net returns (₹ 55147.5/ha) and BCR (3.52) from high yielding pigeon pea variety IPA 203 as compared to the farmers' practice, i.e., 3, 313, 11.50, 9.79, ₹ 29490/- and 2.51, respectively. The growth and yield attributes were considerably lower under farmer's practices because of considerable variation in the extent of adoption of recommended variety and technology depending upon the amount of risk involved in terms of cost, convenience, skill and knowledge about the concerned practice. Average extension gap, technology gap and technology index of pigeon pea were found 5.61, 4.60 q/ha and 23.00% respectively. Variations in the technology gap and index percentage were observed due to variation in agro-climatic parameters, soil fertility, biotic stresses, and socio-economic status and management practices. This variation can be narrowed down by encourage the farmers to adopt economical viable technologies of pulse crops. From evaluation of the technology, it can be concluded that replacement of local/old varieties with new varieties would increase the production and net income of the farmers.

Keywords: BCR, Net income, Pigeon pea, Technology gap, Yield attributing character,

Pigeon pea (*Cajanus cajan* (L.) Millsp.) is an often-cross pollinated (20-70%) crop with diploid (2n=2x=22) chromosome number with genome size of 833.1 mega base pairs (Varshney *et al.* 2012) belongs to the family Leguminosae. It is an excellent source of protein (21.7 g/100 g), dietary fibers (15.5 g/100 g), soluble vitamins, minerals, and essential amino acids (Hardev *et al.* 2016). Globally, pigeon pea is cultivated on an area of 6.99 million ha, yielding a production of 5.96 million tons with an average productivity of 852.40 kg/ha (Food and Agriculture Organization Corporate Statistical Database, 2020). Pigeon pea is the second most important pulse crop after chickpea in India and it is the largest producer and consumer of pulses in the world. Area under pigeon pea in India is about 4.78 million ha during 2018–19 with an annual production of 3.59 million tones and productivity of 751.00 kg/ha (Agricultural Statistics at a Glance 2019). In Uttar Pradesh, pigeon pea crop is cultivated over an area of 0.25 million ha with an annual production of 0.31 million tones and productivity of 758 kg/ha (Agricultural Statistics at a Glance 2019). In 2018-19, district Gorakhpur produced 2238 tonnes pigeon pea from 3576 ha area with average productivity of 630 q/ha (Directorate of Economics and Statistics, Ministry of Agriculture, Government of India 2020). The lower productivity of pigeon pea crop attributed to several factors, i.e. unavailability of high yielding variety, improper sowing, higher seed rate, inadequate and imbalance use of fertilizers, improper weed management, non-adoption of appropriate plant protection measures. Keeping this in view, Mahayogi Gorakhnath Krishi Vigyan Kendra, Gorakhpur, Uttar Pradesh conducted site specific trial on high yielding pigeon pea var. IPA 203 with recommended production technology under the close supervision of KVK scientists. The basic objectives of site-specific evaluation were to identify existing practices that may help to solve major problems of many farmers in defined areas and also create awareness/establishment of new technologies available.

MATERIALS AND METHODS

The present study was carried out at Mahayogi Gorakhnath Krishi Vigyan Kendra, Gorakhpur (Uttar

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Pradesh) in *kharif* at the farmer fields of different villages, viz. Rakhukhor, Chaukmafi and Tedhaveer of Jungle Kaudiya block of Gorakhpur district in Uttar Pradesh during 2018–19, and 2019–20 in rainfed condition on light to medium soil with low to medium fertility status. Technological gap between improved management package and farmers practices were studied based on survey and group discussion with farmer interactive group (FIG) of chickpea growers in selected villages. The farmers of these villages had small and marginal land holdings. The total number of farmers were 120, out of these 40 farmers were chosen at random separately from each village and ten improved management packages were selected to study the technological gap (Table 1). Among these, the 12 innovative farmers were selected for the purpose of the site-specific evaluation in an area of 1.2 ha during both the consecutive year. Two treatments such as farmers practice (use of old variety with mixed seed) was carried out and designated as T_1, and under improved package and practices with high yielding pigeon pea var. IPA 203 were laid out as T_2 in plot size of 1000 m^2 for each treatment. The recommended seed rate (15 kg/ha) and seed treatment with *Trichoderma* @ 5 g/kg seed and *Rhizobium* culture @ 200 g/10 kg seed were applied. The spacing and depth was 60 cm × 25 cm (R × P) and 5 cm respectively. The fertilizers were given as per improved practices as basal dose @ 100 kg/ha DAP. Pendimethalin 30% EC @ 3.3 l/ha + one hand weeding at 45-60 days after sowing were applied. The crops were harvested at perfect maturity stage with suitable method. Need based irrigation and plant protection measures were followed. During the observations, the data were recorded on parameters like plant height (cm), primary branches/ plant, number of pods per plant, number of seeds/pod, grain weight (100 seed weight in g), yield (q/ha) and benefit cost ratio (BCR). The total cost of cultivation and average gross returns were calculated from the average input cost and average market price of the produce during the period of investigation. Based on these, the net income and benefit cost ratio were computed as follows-

Net return (₹/ha) = Gross cost (₹/ha)-Cost of cultivation (₹/ha)

$$\text{Benefit cost ratio (BCR)} = \frac{\text{Gross return (₹/ha)}}{\text{Gross expenditure (₹/ha)}}$$

The yield data were collected from the site-specific evaluation plots as well as control plots (farmers practice) by random crop cutting method and analyzed by using simple statistical tools. The technology gap, extension gap and technological index were also calculated using formula as suggested by Samui *et al*. (2000).

RESULTS AND DISCUSSION

Technological adoption gaps in pigeon pea: The gap between recommended and existing practices of pigeon pea in Gorakhpur district of Uttar Pradesh is presented in Table 1. Full gap was identified for use of high yielding varieties, seed rate, seed treatment and sowing method which definitely was the reason of not achieving potential yield while fertilizer doses, weed management, irrigation management and plant protection measure showed partial adoption gap. Farmers in general used local or old-age mixed varieties instead of the recommended high yielding varieties. Unavailability of seed in time and lack of awareness were the main reasons. Seed rate is the key determinant of plant population. To achieve a desired plant density, seed rate is decided on the basis of seed size, seed purity and germination percentage. Farmers applied higher seed rate than the recommended because they were not aware about importance of proper quantity

Table 1 Technological gap between improved management package and farmers practices under real farming situation

Particulars	Improved management package	Farmers Practices	Technological gap
Land preparation	One cultivator ploughing and 3 ploughing	One cultivator ploughing and 3 ploughing	Nil
Variety	IPA 203	Old and mixed variety	Full gap
Seed rate	15 Kg/ha	Higher seed rate	Full gap
Seed treatment	*Trichoderma* @ 5 g/kg seed and *Rhizobium* culture @ 200 g/10 kg seed	No seed treatment	Full gap
Sowing time	Early: 1st fortnight of June Late: 1st fortnight of July	Early: 1st fortnight of June Late: 1st fortnight of July	Nil
Sowing method	Line sowing (60 -75 cm R × R, 25-30 cm P × P), 5 cm deep	Broadcasting	Full gap
Fertilizer dose	100 kg DAP (18 kg N: 46 kg P_2O_5) and 20 kg sulphur/ha	Use of imbalance fertilizers	Partial gap
Weed management	Pendimethalin 30% EC @ 3.3 lit./ha + One hand weeding at 45-60 days after sowing	Improper chemical weed management	Partial gap
Irrigation	In absence of rain, at flowering /pod development stage	Untimely irrigation	Partial gap
Plant protection measure	Need based biological and chemical insecticide spray	Improper management	Partial gap

of seed. Crop geometry is beneficial over broadcasting as it ensures uniform distribution of seeds, placement of seeds at proper depth, better plant stand, easy in cultural operation and also improved drainage. Proper crop geometry reduces the insect pest population and diseases also. It may be sowing by broadcasting method resulted poor germination and uneven plant population. Farmers were not aware about the importance of recommended crop geometry and lack of interest. Farmers were not using seed treatment technique through seed treatment with *Trichoderma harzianum* @ 5 g/kg seed for wilt management and they are also not using seed treatment technique with *Rhizobium* culture @ 200 g/10 kg seed to fix atmospheric nitrogen in soil for good crop health and production, because of lack of knowledge and interest. The weeds in pigeon pea crop suppress the growth of crop and leading to heavy losses of yield. The degree of yield loss by weeds depends upon the nature and magnitude of weed infestation and also provides shelter for insect pest and diseases which affects yield losses. Crop suffers from a severe weed infestation during 20-60 days which causes drastic reduction in yield. The reason of not using improved weed management practices were mostly attributed by the farmers to the lack of knowledge behind the importance of weed management practices. Pigeon pea is mostly sown as a rainfed crop. If winter rains fail, give one irrigation at pre-flowering stage and another at pod development stage. Majority of the farmers are misguiding as there is no requirement of irrigation in pigeon pea crop. Application of the various fertilizers should be recommended only on the basis of soil test while farmers were using imbalanced doses of fertilizers. Similarly, they were applying injudicious doses of pesticide. This might be due to lack of awareness and knowledge about importance of balanced dose of fertilizers and judicious use of pesticides. Farmers were not aware about timely information and technical guidance because of due to lack of interest and conviction. Most of the farmers were much concerned about importance of land preparation and timely sowing. The above findings were also similar to the findings of Singh *et al.* (2019) and Singh *et al.* (2020a).

Varietal performance of pigeon pea: The adoption of improved management package and practices, viz. high yielding varieties seeds, recommended seed rate, seed treatment, time and method of sowing, recommended dose of fertilizers, weed management and proper plant protection measures are a pre-requisite for getting higher production in any area. The results clearly indicated that the plant height (206), no. of primary branches/plant (06), no. of pods/plant (385), maturity (248 days), seed index (14.80 g/100 seed) and seed yield (15.40 q/ha) was found positively correlated with growth and yield attributing traits as compared with check (farmers practices). Use of improved variety, seed treatment, line sowing, recommended dose of fertilizer for proper supply of nutrients, need based plant protection measure and other agro-techniques might have helped in better crop growth and higher grain yield. The results clearly speak of the positive effect of site-specific trials over existing practice towards enhanced the yield (57.30 %) of pigeon pea crop in location specific rainfed area of the district. The similar trends of crop productivity and yield enhancement in pulse crops have been documented in previous studies by Singh *et al.* (2015).

Technology gap: The difference between the potential yield of the variety and yield of evaluated variety is technology gap. The difference between potential yield of pigeon pea variety IPA 203 and site-specific evaluation of the same variety yield was 4.60 q/ha (Table 2). It indicates that still there is gap in technology demonstration as a result of which the potential yield of the improved practices could not be reaped by the participating farmers. The technology gap observed may be attributed to dissimilarity in the soil fertility status, agricultural practices and local climatic situation. The findings are in line with that reported by Vijaya Lakshmi *et al.* (2017) and Singh *et al.* (2020b).

Extension gap: The difference between demonstrated yield and yield under existing farmers practice is extension gap. The highest extension gap of 5.61 q/ha was recorded in pigeon pea variety IPA 203 (Table 2). This emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies with high yielding variety will subsequently change this alarming trend of galloping extension gap. This finding is in corroboration with the findings of Joshi *et al.* (2014), Kumar *et al.* (2014) and Singh *et al.* (2020b).

Technology index: The ratio between technology gap

Table 2 Growth, yield attributes, gaps and economic performance of pigeon pea var. IPA-203 (pooled data)

Treatment	Plant height (cm)	Average branches/ plant	Maturity (in days)	Pods/ plant	Seed index (100 seed wt.)	Yield (q/ha)	% increase over local check	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index %	Net return (₹/ha)	B:C ratio
T_1 = Farmers practices (Old and mixed variety)	215	03	262	313	11.50	9.79					29490	2.51
T_2=IPA 203 with recommended practices	205	06	248	385	14.80	15.40	57.30	4.60	5.61	23.00	55147.5	3.52

and potential yield expressed as percentage is technology index. The technology index shows the feasibility of the evolved technology at the farmers' field. Higher technology index reflected the insufficient extension services for transfer of technology. The lower value of technology index shows the efficacy of good performance of technological interventions. The average technology index was observed 23.00% in pigeon pea (Table 2). This variation indicates that the result differs according to soil fertility status, weather condition and mismanagement of crop. With adoption of improved practices, the technology gap can be reduced as a result technology index will be reduced. Similar findings were reported by Joshi *et al.* (2014), Kumar *et al.* (2014) and Singh *et al.* (2020b).

Economic performance of site-specific evaluation of pigeon pea crop production technology: Different variables like suitable varieties seed, balanced fertilizers application, seed treatment, time and method of sowing, weed management and plant protection measures etc. were considered as a site-specific evaluation intervention. Economic indicators, i.e. net returns and benefit cost ratio of site-specific trials clearly revealed that in pigeon pea crop, it was substantially higher than control plot (farmers practice) during both the years. The results revealed that the demonstrated varieties have recorded higher net returns and benefit cost ratio over farmers' practice. Demonstrated variety IPA 203 have recorded ₹ 55147.50/ha of net returns and benefit cost ratio of 3.52 over farmers practice (₹ 29490.00/ha net returns and benefit cost ratio of 2.51). The higher gross and net monetary return realized by the farmers indicate the economic feasibility of the technology (Singh *et al.* 2020b).

The site-specific evaluation of pigeon pea production technology with high yielding varieties produces a significant positive result and provided the researcher an opportunity to demonstrate the productivity potential and profitability of the latest technology under real farming situation, which they have been advocating for long time. The productivity gain under site-specific evaluation over existing practices of pigeon pea cultivation created greater awareness and motivated to the other farmers to adopt suitable production technology of pigeon pea in the district. Efforts should, therefore, be made by the extension agencies in their transfer of technology programmes to increase the production of pigeon pea.

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