Breeding for the future: assessing farmers' preferences for potato varieties in heat-prone Gujarat, India

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A key challenge in crop improvement research is to anticipate farmers' continuously changing preferences for varieties. Thus farmers' perspectives are now widely considered an important input in varietal development programmes. In India, potato production is increasingly constrained by abiotic stresses due to the fast-changing climate and agro-environment. Under an on-going crop improvement research project, analysis of farmers' expectations from new potato varieties in heat-prone production environment of Gujarat state was undertaken. CIP, CPRI and PRS-Deesa jointly conducted a diagnostic survey in Gandhinagar district in February 2009. The survey elicited farmers' perceptions on key traits preferred by cultivators, consumers and markets. Results revealed that a high proportion of respondents (98.5%) believed high yielding attributes; heat-tolerance (95.5%); late-blight resistance (81.5%); and drought resistance (69.0%) traits in new varieties will have the potential to further increase their potato yields. Heat susceptibility, poor yield, late maturity and late blight susceptibility were vital reasons for farmers to discard potato varieties in the past. Sizable respondents considered heat (94%) and drought (31%) as serious threats to potato production. Farmers' priority index (0-100) and percent relative importance for top ten potential attributes in new potato varieties were also listed. Heat tolerance (priority index = 92 and relative importance = 22.43%) was the top priority followed by high yield, resistance to late-blight and resistance to potato-tuber-moth etc. Survey findings are being incorporated in efforts to validate and refine the research project's key assumptions, target outputs and expected outcomes on potato farmers' livelihoods.

Keywords: Heat-tolerant potato varieties, Varietal attributes, Abandonment of potato varieties, Priority index for breeding potato varieties.

Introduction

Potato is world's fourth most important food crop after rice, wheat and maize. India is the third largest potato producer after China and Russia. Due to well developed indigenous research and development India has the highest potato productivity among the top three potato producing countries.

Importance of potato in the world's food security and poverty elevation is reflected by the statement of Jacques Diouf, the Director General, FAO "The potato is on the frontline in the fight against world hunger and poverty" (FAO, 2008). Food security issues in Indian context have been thoroughly addressed at several fora (Acharya, 2009 and Chand, et al., 2007; to mention a few). Contribution of potato in the socio-economics of Indian people has been highlighted by Shekhawat and Naik, 1999.

Among potato producing states in India, Gujarat has shown the highest potato production and productivity at annual compound growth rates during recent years (Kesari and Rana, 2008). Over the same period the share of Gujarat in national potato production has also increased. The latest official potato production data shows that Gujarat has replaced Punjab as the third largest potato producing state in India after Uttar Pradesh and West Bengal (GOI, 2009). Gujarat also has the distinction of attaining the highest potato productivity in all Indian states during 2004-05 to 2007-08.

Global warming was perceived as the biggest future threats to Indian agriculture in general and potato in particular (Lal *et al.*, 2008). Decline in potato production was estimated by (Singh, *et al.*, 2008). However, the study estimated severer reduction in potato production in states like Karnataka, Gujarat, Maharashtra and Madhya Pradesh.

Ill effects of high temperature on potato during tuber initiation and tuber bulking stages were reported by Basu and Minhas, 1991; Minhas and Kumar, 2005. Development of heat tolerant potato varieties was considered an important tool to tackle global warming. Such varieties are supposed not only to enhance potato production in warmer areas but also to extend potato cultivation to non-traditional areas. Keeping these points into consideration a project funded by GTZ "Enhanced Food and Income Security in SWCA through Potato Varieties with Improved Tolerance to Abiotic Stress" was initiated

Present paper is an outcome of a diagnostic survey targeted to understand what attributes farmers want in future potato varieties in relatively heat stressed Gandhinagar district of Gujarat.

Methodology

Gandhinagar of Gujarat being one of the hottest potato growing districts was purposively selected for this study. Premnagar, Indirapura and Nandol were randomly selected three villages in the selected district. The survey conducted in February 2009 was an attempt to know farmers' perception on potato yield enhancing attributes, desirable and undesirable characters of existing potato varieties, reasons of varieties abandonment in the past, extent of abiotic stress experienced, and priority of desirable characters in the future potato varieties.

Potato growers were divided in four farm categories viz., marginal (up to 2.5 acre potato area), small (more than 2.5 and up to 5 acre potato area), medium (more than 5 and up to 10 acre potato area) and large (more than 10 acre potato area). Overall 93 households were covered in the survey. In the process of respondents' selection care was taken that all farm categories were represented. Information on the profile of sample villages was procured from *Panchayat* (Village council) records. Before finalizing, the interview schedule was circulated among multidisciplinary team of scientists involved in the project. Personal interview method was used for data collection.

Simple mathematical and statistical techniques were used to analyse data and draw conclusions. As a guide for developing future potato varieties priority index and relative importance of desirable varietal attributes were computed. Priority index ranged from 0 to 100 where percent multiple responses were assigned weights (1^{st} response = 2; 2^{nd} and 3^{rd} responses = 1; subsequent responses = 0.5) on open ended questions. Relative importance of top ten desirable varietal attributes was simple percentage of their priority indices. For testing independence among potato farmers' categories on various factors/ attributes, chi-square test (Gupta, 2009) was applied.

Results and discussion

Yield enhancing attributes: Every respondent farmer believed that there was scope for further increasing his potato yield. Highest proportion of farmers believed that high yielding new potato varieties (98.5%) followed by heat tolerant potato varieties (95.5%), proper late blight control (81.5%), water saving technologies (especially the drip irrigation; 74.6%) and drought tolerant varieties (69.2%) can further increase their potato yield. With the help of Chi-square test it was found that farmers of different categories had perceived differential importance for role of soil reclamation, fertilizer doses, low prices of inputs and better agricultural extension services in increasing their potato yield at 1% level of significance. Marginal farmers assumed higher importance of drought tolerant potato varieties and need of better agricultural extension services for increasing their potato yields. It was found that ground water table in the study area was very deep and marginal farmers were not having assured source of irrigation. Progressive farmers, who are generally targeted by extension agencies, were found not extending information to the poor and marginal farmers.

Desirable and undesirable characters: Among the desirable characters of existing potato varieties higher yield, early maturity, desirable (large and uniform) tuber size, good storability, higher price of the output and suitability for processing were the important ones preferred by the farmers. Contrarily low yield, susceptibility to heat and late blight, late maturity, bad storability and low price of the output were important undesirable characters disliked by potato farmers. Here bad storability means higher storage losses at ambient temperature as well as during cold storage.

Reasons for abandoning varieties: Potato varieties continuously not grown by a potato farmer for last five years were considered abandoned. Low yield as a reason for abandoning varieties was reported by the highest

number of respondents. Late blight susceptibility, low yield, problem of tuber cracking during bulking stage, longer duration of maturity, low output price, heat susceptibility and poor storability were other important reasons that compelled farmers to abandon potato varieties in the past. Tubers of one of the variety (Kufri Pukhraj) fetch lower prices on account of early (pre mature) harvesting, lower dry matter and poor storability.

Heat and drought stress: Heat and drought were the highly important abiotic stress factors faced in potato cultivation in the study area. About ninety four percent respondents believed that heat was a limiting factor towards achieving higher yield levels while a lower proportion (31.5%) of respondents perceived drought as abiotic stress to their potato crop. More crucial aspect of this problem was experience of drought stress by higher proportion of small and marginal potato farmers. Small and medium farmers heavily or sometimes entirely depend on larger farmers for irrigation water which they get at relatively higher charges. Large farmers may not provide them irrigation water at the right time according to formers' personal needs. Development of potato varieties that can give normal yield at least at 2^{o}C higher minimum night temperature (i.e. 22^{o}C) than the conventional potato varieties were estimated to increase potato yield in states like Karnataka and Gujarat by at least 20%

Priorities of varietal attributes: Previous year (2008-09 crop year) was a hot year and farmers experienced significant yield losses in many states of India on account of high temperature (CPRI, 2009). The sampled farmers showed heat tolerance in potato varieties as their first priority (index = 92 and relative importance = 22.43%) followed by high yield, resistance to late-blight, resistance to potato-tuber-moth and large but uniform tubers. High potato yield was relatively less important agenda on the rating scale of large farmers as they were more concerned with quality attributes than just the higher yield. Large farmers, which are generally the trend setters, had higher focus on resistance to late blight followed by processing grade varieties, resistance to potato-tuber-moth and early maturing potato varieties. Chi-square statistics showed that respondents among different farm categories had independent preferences for high yield, resistance to late blight, resistance to potato-tuber-moth, suitability for processing, early maturity and shining skin at 1% level of significance.

India in general and Gujarat in particular have shown tremendous growth in potato processing sector (Rana and Pandey, 2007). Raw material (processing grade tubers) demand of potato processing industry in India was estimated 2.678 million MT during 2010-11 (Rana and Pandey, 2007). This demand constitutes 10.76% of Indian average potato production during TE 2007-08 (GOI, 2009). Rana and Pandey (2007) clearly indicated that proportion of processing grade tubers required (from state's production) in this state was much higher than the national one. Although the varietal attribute suggesting suitability of potato variety for processing has got seventh highest priority ranking yet, the breeders need to assign a higher importance to this attribute.

Marginal farmers owing to low volume of produce have the tendency of avoiding marketing risk and try to sell at the farm itself or storing the produce using conventional methods. Hence improved storability as an attribute in new potato varieties is likely to be more beneficial to the resource poor potato farmers having small land holdings.

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