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Short Communication

A study to identify research priorities in the area of conservation of vegetable germplasm and variety development

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Vegetables are rich source of minerals, vitamins, vegetable fiber and contain fair amount of carbohydrate and protein (Singh *et al.* 2012). Vegetables contain high amount of nutraceuticals which helps fight diseases, hence called protective food. Over the last two decades it has been observed that, there is a change and shift in food habits of Indian population and consumption of fruits and vegetables have been increased, but the productivity of vegetables is 17.3 t/ha which is not sufficient to meet projected requirement of producing 225 mt of vegetables by the year 2030 (Roy *et al*. 2016). To increase productivity superior varieties of vegetables are required which are resistant to disease pest and other abiotic and biotic stresses and contain high nutritive value. Conventionally cultivated and wild species of vegetables are known to be good carrier of genes responsible for disease-pest resistance, climate resilience and enriched with high amount of nutraceuticals. But in modern times farmers have stopped cultivating conventional vegetable varieties as they yield less, even many varieties have been extinguished. It has become a threat for future vegetable breeding programme. So conservation of vegetable genetic resources and development of superior varieties is very important in vegetable sector. Research organizations are conducting research in this line in our country. But the researches are unorganized. Database is not maintained properly, accession of information regarding genetic information and accession of germplasm is not easy. Repetition of same research conducted which results in exploitation of resources and energy. With this background, a study was designed with the objective to identify the priority issues in the sector of conservation of vegetable genetic resources and variety development.

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The study was conducted through online survey. The survey questionnaire had been sent to 50 scientists of ICAR institutes, 50 teachers of SAUs and 50 subject matter specialists of KVKs sampled purposively who deal with vegetable crops, for their response. Among them 75 respondents replied from 22 different states representing different agro-climatic regions of India (Table 1). The questionnaire contained objective type of questions related to problems in conservation of plant genetic resources and variety development in vegetable sector and the respondents were asked to score each problem in a five point continuum ranging most important (5), important (4), undecided (3), less important (2) and not important (1) as they perceived. The total score for each problem was obtained by summing the scores given by 75 respondents.

For obtaining weightage of each problem, 10 subject experts sampled randomly from the concerned fields were asked to score the problems in a three-point continuum ranging most urgent, urgent and less urgent and give a score of 3, 2 and 1 respectively. Those 10 Subject experts had not been selected as respondents in the study. The weightage for each problem was calculated with the following formula:

$$\text{Weightage} = \frac{\text{Obtained score}}{(\text{Maximum possible score}) - (\text{Minimum possible score})}$$

Weighted sum was calculated by multiplying weightages of the individual problems with the total score obtained and the weighted average (WA) was obtained by dividing the weighted sum with the total number (75) of respondents. Linear Regression analysis was done among the problems considering rank 1 problem as dependent variable while others as independent to know in what proportion (R^2 value) the independent variables influence the dependent variable. The â-value represents 1 unit change in the corresponding independent variables will change the dependent variable equal to the corresponding â-value.

Table 1: Distribution of the respondents from different states of India

State	Number of respondents		
	ICAR institutes	SAU	KVK
Jammu and Kashmir	-	1	1
Himachal Pradesh	-	5	-
Punjab	-	1	-
Haryana	-	1	-
Rajasthan	-	2	1
New Delhi	1	-	-
Uttar Pradesh	15	-	1
West Bengal	2	4	1
Odisha	-	-	1
Chhattisgarh	-	-	1
Gujrat	1	7	2
Maharashtra	1	1	-
Andhra Pradesh	1	3	3
Karnataka	1	2	2
Kerala	-	1	1
Tamil Nadu	2	1	1
Goa	1	-	-
Assam	-	1	1
Arunachal Pradesh	-	-	1
Nagaland	-	-	1
Manipur	-	-	1
Andaman and Nicobar Island	1	-	-
Total	26	30	19

Lack of climate resilient varieties (Drought, Flood, Heat, Salt tolerance) in vegetables: According to 59% and 27% respondents lack of climate resilient varieties in vegetables was most important and important issue of research (Table 2)and stood as top most priority issue with weighted average score of 4.98 (Table 3). The changing patterns of climatic parameters like rise in atmospheric temperature, changes in precipitation patterns, excess UV radiation and higher incidence of extreme weather events like droughts and floods were emerging major threats for vegetable production in the tropical zone (Tirado et al., 2010). Vegetable crops are very sensitive to climate vagaries and sudden rise in temperature as well as irregular precipitation at any phase of crop growth can affect the normal growth, flowering, pollination, fruit development and subsequently decrease the crop yield (Afroza et al., 2010). Improved, adapted vegetable germplasm is the most cost-effective option for farmers to meet the challenges of a changing climate. However, most modern cultivars represent a limited sampling of available genetic variability including tolerance to environmental stresses. Breeding new varieties, adapted to a wider range of climatic conditions could result from the discovery of novel genetic variation for tolerance to different biotic and abiotic stresses.

Vegetable genetic resources are not being characterized for biotic and abiotic stress: Genetic resource or germplasm characterization is the recording of distinctly identifiable characteristics, which are heritable (Upadhyaya *et al*. 2008). According to 16% and 49% respondents it was most important and important area of vegetable research and stood 2nd in research priority issue with weighted average 4.63, â= 0.22. An accurate characterization of vegetable germplasm will be fundamental for cost-efficient management of germplasm collections, both in situ and ex situ and understanding phylogenetic relationships among species (Bolot *et al.* 2009), the assembly of core collections suitable for association mapping studies and assessing genetic similarity among accessions sharing common ancestors required for farther research.

Erosion of local genetic resources of vegetables: Wild species are known to be good carrier of genes responsible for disease-pest resistance and climate resilience (Roy *et al*. 2016). Conservation of local genetic resources of vegetables was found to be the 3rd priority issue (WA=4.58, â= 0.20), as the scientists and policy makers are increasingly aware of the seriousness of the disappearance of the earth's genetic heritage and accordingly to 59% and 31% respondents selected it as most important and important priority issue for research. Although much of the debate focuses on animals and wild plant species, there is growing recognition that the diversity of cultivated crop species has vastly diminished and threatening the future of agricultural development (Tripp and Heide 1996). Urgent action is also required to collect and preserve irreplaceable genetic resources

Table 2: Percent distribution of the respondents categorized priority parameters from most important to not important

Parameters	Most Important (5)	Important (4)	Undecided (3)	Less Important (2)	Not Important (1)
Lack of climate resilient varieties (Drought, Flood, Heat, Salt tolerance) in vegetables	59	27	12	3	0
Vegetable genetic resources are not being characterized for biotic and abiotic stress	16	49	23	9	3
Erosion of local genetic resources of vegetables	59	31	8	3	0
Non availability of genetic resource information in public domain	51	24	16	9	0
Disease- pest resistant variety of vegetables not performing well	44	35	16	5	0
Lack of resource use efficient varieties	40	35	21	1	3
Lack of simulated environments/ screening facilities for breeding	63	24	11	1	1
Some recommended / released varieties of vegetables are not popular	41	40	11	8	0

Table 3: Variety development and conservation of plant genetic resources

Parameters	Weightage	Weighted Sum	Weighted Avg	Rank	β	t	Sig.
Lack of climate resilient varieties (Drought, Flood, Heat, Salt tolerance) in vegetables	1.12	374.08	4.98	1	-	-	-
Vegetable genetic resources are not being characterized for biotic and abiotic stress	1.04	347.36	4.63	2	0.220	1.747	0.086
Erosion of local genetic resources of vegetables	1.04	344.24	4.58	3	0.205	1.541	0.128
Non availability of genetic resource information in public domain	0.95	296.40	3.95	4	0.324	2.460	0.017
Disease- pest resistant variety of vegetables not performing well	0.95	295.45	3.93	5	-0.119	-0.875	0.385
Lack of resource use efficient varieties	0.91	278.46	3.71	6	0.025	0.167	0.868
Lack of simulated environments/ screening facilities for breeding	0.91	270.27	3.60	7	0.033	0.234	0.816
Some recommended / released varieties of vegetables are not popular	0.91	268.45	3.57	8	-0.114	-0.811	0.421
$R^2 = 0.356$							

(Frankel 1974).

Non-availability of genetic resource information in public domain: In this regard the 4th priority issue (WA=3.95, â= 0.32) identified was non-availability of genetic resource information in public domain. There are concerns that a country that hosts an important international collection can deny information to another country due to advent of intellectual property protection for crop varieties or due to political reasons (Tripp and Heide 1996). Although it is generally accepted that significant amount of genetic erosion has occurred and is still occurring, there is little data available on its amount and extent. Without remedial action, genetic erosion will inevitably increase, and the costs of replacement of diversity needed in the future by the community will be much greater (Harmer and Teklu 2008).

Disease-pest resistant variety of vegetables not performing well: The fifth priority issue (WA=3.93, â=0.193) identified was nonperformance of disease pest resistant variety of vegetables. That may be due to climatic change, there are possibilities of emergence of new strains of diseases and pests that may lead to breakdown of resistances in present day varieties (Kamoun 2001). According to 44% respondents it was most important and according to 35% respondents it was important issue of research.

Lack of resource use efficient varieties: Resource efficient varieties of vegetables can reduce the cost of cultivation of the farmers. Judicious use of inputs in cultivation can save the environment as well as money. Farmers often use overdose of fertilizers and growth elements in vegetables in hope of getting more yield. Uneconomic use of fertilizers in vegetable production enhances the cost of cultivation is a matter of concern (Gilden et al. 2010). Water requirement is very high in vegetable production, resulting in weed problem in the field. If varieties of vegetables available which require less water, consume less fertilizers, resistant to insect pest it will be a money saver for the farmers. According to 40% and 35% respondents lack of resource efficient varieties in vegetables was most important and important area of research respectively.

Lack of simulated environments/ screening facilities for breeding: According to 63% respondents, lack of simulated environments/ screening facilities for breeding was the most important and according to 24% respondents important constraints to be addressed for future research and stood 7th position in priority study.

Some recommended/released varieties of vegetables are not popular: Location specific improved varieties of vegetables and production technologies have been developed by the research organizations, but it has not reached to the farmers or not available in the market from where the farmers can get it easily. Although demand of recommended/ released varieties of vegetables is there but availability in the seed chain becomes main problem and hence stood 8th important issue of intervention in priority study.

Eight issues have chronologically been prioritized in the area of conservation of vegetable germplasm and development of superior verities which will help breeders, researchers to plan their research programme as well as policy makers and research managers will get a guideline in proportionate allocation of resources. Also previously set priorities should be periodically reviewed to ensure that priorities are up to date. Furthermore, to make research prioritization legitimate, an appeal mechanism for the established priorities should be considered, providing opportunity for feedback. Not only can this provide insight into priorities that have remained devoid of attention, but it can also enforce discussion on implementation issues.

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