Productivity of summer squash (*Cucurbita pepo* L.) under trench protected structure in cold desert Ladakh, India

Abstract

Early growing season and later harvest season encounter with low temperatures restricting summer squash cultivation commercially in Ladakh. Summer squash cultivation in Ladakh have generally been restricted to limited pockets due to lack of awareness about technological advancement like cultivars and proper protected structure. Moreover, poor quality planting material is also responsible for low productivity even in protected structures. Hence, varietal trial under trenches was conducted with a view to improve yield and availability period. Results revealed that summer squash var. All Green was highest yielder(1206.875 Q/ha) with highest fruit weight (1.838 kg)and number of marketable fruits(5.75). More than 200 per cent increase insummer squash yield is observed in trencheswith variety All Green as compared to variety Australian Green.Therefore, production technology comprising trench and summer squash variety All Green mightbe up-scaled to similar climatic condition with high wind velocity to enhance farm income of the farmers.

Key words: Cold arid, Ladakh, summer squash, trench

Introduction

"Summer squash (*Cucurbita pepo* L.) is an economically important member of the gourd family, Cucurbitaceae. Summer squash is a warm season, New World vegetable crop, well adapted to temperate and sub-tropical region. It is a quick growing and early yielding cucurbit which performs well in cool and moist weather conditions"[1]."It ranks high in economic importance among vegetable crops worldwide. A native of North America, summer squash has been grown in Europe since the renaissance. There are six extant horticultural groups of summer squash: cocozelle, crookneck, scallop, straightneck, vegetable marrow, and zucchini"[2]."Most of these groups have existed for hundreds of years. Their differing fruit shapes result in their differential adaptations to various methods of culinary preparation. The groups differ in geographical distribution and economic importance. The

zucchini group, a relatively recent development, has undergone intensive breeding in the United States and Europe and is probably by far the most widely grown and economically important of the summer squash.Summer squash is also known as bush squash, vegetable marrow, Vilayati Kaddu/Chappan Kaddu/Safed Kaddu in India". [3]

"Ladakh is the high altitude Trans Himalayan region of India. The area is sandwitched between the Greater Himalayas in its south and the Karakoram ranges in the north. The major portion of Indian cold arid (68321 sq Km out of total 74809 sq Km) constituted by Ladakh.Such a geographical setting manifests itself into some peculiar agro-climatic conditions that prevail in High Himalayas. Extreme cold and aridity coupled with large seasonal as well as diurnal variation in temperature are limiting factors affecting agricultural productivity adversely. In Ladakh region, cold desert of India, summer squash cultivation is mostly confined inthe vicinity of Leh townwhere summers are mild, the sowing season starts from May and the crop matures in July onwards.Early growing season and later harvest season encounterwith low temperatureswhich is a major constraintrestricting vegetable grower to cultivate summer squash commercially by adversely affecting crop growth and yield. Summer squash cultivation in Ladakh have generally been restricted to limited pockets due to lack of awareness about technological advancement like variety and proper protected structure. Beside this, low quality planting material are responsible for low productivity even under protected cultivation"[4].Though Ladakh region have various types of protected structuresviz. polyhouses, trenches and low tunnels, the trench cultivation has proven its worth in realizing more output per unit of inputs and resources bestowed on to land as an alternative to raise production and productivity especially to meet own requirements. Seeing the efficacy, there is need of harnessing and leveraging the potential of trench cultivation on commercial scale with variety of vegetables.A number of improved cultivars are available in this crop but no effort has been made so far to evaluate them for their suitability of growing under protected condition in Ladakh. Therefore, varietal evaluation is felt essential to identify suitable varieties for its production with superior attributes.

Materials and Methods

The experiment was conducted during summer in trenches (Size 10 ft long x 6 ft wide x1.5-2ft deep) at Vegetable Research Farm, Stakna (Leh) of High Mountain Arid Agriculture Research Institute (SKUAST-K)which is situated at 3319 m amsl with latitude $33^0$58.551' NS and longitude $77^0$41.995' EW. During the technology-generation stage of trenches, special attention was given to resource poor farmers of Ladakh [5]. Trench structure does not require much skill in its construction and management. Its cost is lower among most of the green houses and being an underground structure, heat losses are minimum [6, 7, 8]as strong winds do not affect polythene cover much and hence it is long lasting.

The climate of the area is typically dry temperate with extreme fluctuations in the temperature and high wind velocity.As the trenches are underground, high wind velocity can be overcome in these structures. Soil of the experimental field wassandy loam. The experiment was laid out in RCBD with five genotypes replicated 4 times. Data were recorded for7 characters and subjected to statistical analysisas per Panse and Sukhatme [9].Comparison was done among varieties for their performance.

Results and Discussion

Though food security in Ladakh is taken care of by an efficient PDS, nutritional and income insecurity are the principal concern for the policy makers. Fresh vegetables and fruit are always in short supply in the region. Harvesting more return from a unit area of land, disguised unemployment, improper availability of fruits and vegetables, malnutrition, generating employment, diversification and satiating needs of dominion population are major concern awaiting for strategic initiation and integration having bearing on hastening production and quality.Though, Summer squash (*Cucurbita pepo* L.) is not a major crop of Ladakh region and is grown on small scale during summers in Ladakh region, its early availability for consumption may attract the farmers. Although, it can grow in open field conditions in lower belts of Leh district but its real potential can be realized only under protected structures.The analysis of variance (Table 1) indicated that there werehighly significant differences among genotypes under study for plant height, harvest duration, fruit weight, fruit length and fruit diameter and significant differences for yield per ha. Yoldas [10] also reported that varieties had statistically significant effects on yield. Non- significant variation was observed among genotypes for number of fruit per plant.

Plant characters

Thedata for plant characters in Table 2 indicated that summer squash variety All Green had highest plant growth (137.75 cm) which was superior to all the genotypes except Seol Green. All the genotypes non significantly different from each other for number of fruits being highest in genotype All Green. Likewise,variety All Green was also found to be highest yielder (1206.875 qt/ha) and was at par with Dark Green Zucchini and Seol Green.Pandey et al. (2018) recorded maximum yield of 1033.72 qt/ha in polyhouse conditions in Terai region of Uttrakhand.Significantly longer harvest duration (112.5 days) was recorded in variety All Green as compared to the other genotypes.More than 200 per cent increase in summer squash yield was observed in trenches with variety All Green as compared to variety Australian Green.Average yield recorded under open field conditions in Ladakh was only 350-400 qt/ha with shorter harvest duration of 60-80 days only [11]. Pandey et al. [1] also reported significant increase for fruit yield and number of fruits per plant in polyhouse condition over open field cultivation.

Fruit characters

Mean performance of summer squash genotypes for fruit characters is also given in Table 2. Four genotypes viz All Green, Seol Green, Pusa Alankar and Dark Green Zucchini exhibited performance at par with each other for fruit weight.Pandey et al. [1] recorded maximum average fruit weight (1320 gm) in variety Cora in polyhouse conditions.

Similarly, all these four varieties were at par with respect to fruit length. All Green showed significant superiority for fruit diameter overall the other genotypes except Seol Green and Pusa Alankar.

The overall mean weight, length and diameter recorded in the present studies were 1.463 g, 37.53 cm and 91.792, respectively which are quite higher than the reported values of 828 g, 18 cm and 89 mm, respectively in 22 genotypes [12]. Higher value in present studies may be due to the difference in genotypes as well ashigh solar intensity in Ladakh. In consonance with the present findings, Pandey et al. [1] also observed significant increase in polyhouse condition over open field cultivation for fruit yield, number of fruits per plant and fruit weight.

Conclusion

Results of present investigationrevealed that variety All Green is the highest yielder with highest fruit weight and no. of marketable fruits. Hence, Summer squash variety All Green may be recommended for cultivation in trenches in Ladakh. The production technology of summer squash variety All Green in trenches might be up-scaled to similar climatic condition with high wind velocity to enhance farm income of the farmers.

References

1. Pandey B.K., Maurya S. K., Bhatt Lalit, Pooja, Chauhan D. S. 2018.Performance of summer squash (*Cucurbita pepo* L.) under protected conditions in Terai Region of Uttrakhand. Field Crops, 1(2): 1-4.
2. Paris Harry. 1996. Summer Squash: History, Diversity, and Distribution. HortTechnology, 6: 6-13. 10.21273/HORTTECH.6.1.6.
3. Thamburaj S., and Singh N. 2001. Textbook of Vegetables, Tuber crops and Spices. Indian Council of Agricultural Research, New Delhi, 286p.
4. Singh P.K., Maurya S.K., Singhal P. and Joshi G. 2010. Performance of Summer squash for off season cultivation under protected condition in tarai region of Uttarakhand. National Seminar on Protected Cultivated of Vegetables and Flowers-A value chain approach (11-12 January, 2012; Pantnagar, India). Book of Abstracts, 12
5. Mishra G. P., Singh N., Kumar H. and Singh, S. B. 2010. Protected Cultivation for Food and Nutritional Security at Ladakh. Defence Science Journal, 61(2):229-225
6. Singh B. and Dhoulakhandi A.B. 1998. Application of solar greenhouse for vegetable production in cold desert. In: Renewable energy: Energy efficiency policy and the environment. Elsevier Science Ltd, UK, pp. 2311-314.
7. Akbar P. I., Kanwar M. S., Mir M. S. and Hussain A. (2013). Protected vegetable cultivation technology for cold arid agro-ecosystem of Ladakh. International Journal of Horticulture, 3 (19): 109-113
8. Spaldon Sonam, Hussain Anwar, Angmo, Kunzes Kanwar, M. S. LaskitJigmet, TundupPhunstog and DolkerDiskit. 2023. Protected vegetable cultivation for climate resilience and nutritional security in Eastern Ladakh, India. Current Sci. . 125 (7): 737-742

9. Panse V G and Sukhatme PV.1985 Statistical Methods for Agricultural Workers. 2nd ed. ICAR, New Delhi.
10. YOLDAŞ F. 2014. Effect of plant variety and growing methods on yield and quality in summer squash. Agriculture and Food Sci:358-363
11. PFDC, Leh. 2011. Annual Progress Report. Precision Farmimg Development Centre, High Mountain Arid Agriculture Institute.
12. Martínez-Valdivieso, D., Gómez P., FontR, Alonso-Moraga A. and Del Rio-Celestino, M. 2015. Physical and chemical characterization in fruit from 22 summer squash (*Cucurbita pepo* L.) cultivars. LWT-Food Science and Technology, 64(2), 1225-1233.

Table 1: Analysis of variance for different characters

Sources of variation	df	MSS						
		Plant height	No. of fruits	Yield/ha	Harvest duration	Fruit weight	Fruit length	Fruit diameter
Genotypes	4	3926.075**	0.575	337179.22*	241.125**	0.583**	98.439**	437.103**
Replications	3	34.467	0.600	64315.00	47.783	0.148	2.366	96.207
Error	12	156.008	0.642	62593.38	33.658	0.088	9.189	43.987

**Significant at 1% level of significance

* Significant at 5% level of significance

Table 2: Mean performance of summer squash genotypes for various characters in trenches

Genotypes	Plant characters				Fruit characters		
	Plant height (cm)	No. of fruits/plant	Yield/ ha (qt)	Harvest duration (days)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (mm)
Australian Green	63.75	4.75	394.375	90.75	0.831	28.975	75.370
Pusa Alankar	94.00	5	770	99.25	1.525	40.40	93.930
Dark Green Zucchini	87.00	5	871.250	101.25	1.456	40.225	89.285
Seol Green	132	5	855	100	1.663	37.40	97.395
All Green	137.75	5.75	1206.875	112.5	1.838	40.65	102.98
Mean	102.9	5.1	819.5	100.75	1.463	37.53	91.792
CD(0.05)	19.245	NS	385.484	8.939	0.457	4.671	10.219