

Short Communication

## Punjab Swarna: high yielding tomato variety for naturally ventilated polynet house cultivation

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Tomato (*Solanum lycopersicum* L) is one of the important commercial vegetable grown under protected conditions, where environment is modified to suitable conditions for optimum plant growth which leads to production of quality tomatoes suitable for exports and domestic consumption. Previously, the Punjab Agricultural University has developed and recommended two indeterminate table varieties such as 'Punjab Gaurav' and 'Punjab Sartaj' (Dhaliwal and Jindal 2018a), three cherry tomato varieties viz. Punjab Red Cherry (Dhaliwal and Jindal, 2017); Punjab Sona Cherry and Punjab Kesar Cherry (Dhaliwal and Jindal, 2018b) for commercial cultivation in Punjab. Focusing on breeding for quality in tomato, yellow coloured Punjab Sona Cherry and orange coloured Punjab Kesar Cherry rich in carotene content were developed. The development of these varieties results in creating awareness regarding quality among tomato growers, thus, in turn demand for table tomatoes of other colours specially yellow, orange or pink etc was increased in the state. In view of that, the orange coloured table variety 'Punjab Swarna' was developed and now become available for tomato growers of the state for cultivation under polynet house. The orange fruit colour of 'Punjab Swarna' makes this variety for use where additional flavor or retinoid activity is desired. Stommel et al. (2005) also demonstrated the importance of color on consumer perceptions of fruit quality. Based on the field performance and due to the importance of carotene content in human diet, this variety was released by Punjab State Varietal Approval Committee for commercial cultivation in the state.

The trials were conducted from 2013-14 to 2016-17 at PAU, Ludhiana by taking newly developed tomato

cultivar 'Punjab Swarna' along with previously released varieties Punjab Gaurav and Punjab Sartaj; and a commercially grown indeterminate hybrid 'G-600' (from Golden Seeds Private Limited, India) and hybrid 'Heemshikhar' used as checks were evaluated in a naturally ventilated polynet house. During 2015-16, the experiment was conducted at other locations i.e at Krishi Vigyan Kendras (Farm Science Centre of PAU Ludhiana) situated at Sangrur, Bathinda and Jalandhar, in addition to PAU, Ludhiana in completely randomized block design with 3 replications in a naturally ventilated polynet house. During 2016-17, on farm testing (adaptive research trials) was done at 22 locations of the state. The data was recorded for early yield (q/ ha), total yield (q/ ha), fruit weight (g), days to first harvest, number of fruits per cluster, number of clusters per plant, fruit shape index (P/E diameter), pericarp thickness (mm), number of locule per fruit, dry matter (%), total soluble solids (TSS, °Brix), acidity (mg/ 100 ml juice), ascorbic acid (mg/ 100 ml juice), total carotenoids (mg/ 100 g), lycopene content (mg/ 100 g), late blight (% disease index), root gall index (0- 5 scale), leaf curl virus (% incidence), percent fruit damage by *Heliothis armigera*, number of aphid and whitefly population present per 50 leaves. The disease data on late blight, root gall index and leaf curl virus under artificial conditions was recorded as per the method given by Thind et al. (1989), Taylor and Sasser (1978) and Muniyappa et al. (1991), respectively whereas the data on percent fruit damage, number of aphid and whitefly was recorded under open field conditions in non sprayed conditions. However, the performance of 'Punjab Swarna' and checks are based on the overall mean obtained from the 3 levels of evaluation trials under polynet house conditions. The data collected at PAU and other locations were subjected to analysis to calculate least square differences; adaptive trials from 22 locations were averaged. Early yield comprised fruit harvest till the end of March since the

**Table 1:** Performance of indeterminate tomato varieties/hybrids at On-station research, multilocation and On-farm trials

Variety/ Hybrid	Yield(q/ha)			
	On station research trials (average of 4 years)	Multilocation research trials (average of 4 locations)	On farm trials (average of 22 locations)	Overall mean
Punjab Swarna	2844.67	2769.59	2543.20	2719.15
Punjab Gaurav (Check)	2247.30	2279.33	2206.73	2244.45
Punjab Sartaj (Check)	2112.91	2143.33	2000.64	2085.63
Hybrid G-600 (Check)	1943.74	1932.46	-	1938.10
Hybrid Heemshikhar (Check)	2010.67	-	2067.68	2039.18
CD @ p=0.05	109.19	226.06	111.83	-

normal crop harvest in open starts in April. Fruit weight was recorded by taking mean of ten representative fruits.

**Performance for early and total yield:** In local research trials, first picking of Punjab Swarna was possible 120 days after transplanting (Table 2) which was at par with Punjab Gaurav (120) and G-600 (119) but 2.65% late than Punjab Sartaj (116 days) and 9% than Heemshikhar (110 days) respectively. Similarly, early yield (harvested till end March) of the hybrid G-600, hybrid Heemshikhar, Punjab Sartaj and Punjab Gaurav was 516.89q ha<sup>-1</sup>, 465.89 q ha<sup>-1</sup>, 455.48 q ha<sup>-1</sup> and 442.85 q ha<sup>-1</sup> which was 19.59%, 10.78%, 8.74% and 6.14% more than Punjab Swarna (415.65 q ha<sup>-1</sup>) respectively (Table 2). For total yield, Punjab Swarna recorded average fruit yield of 2844.67q ha<sup>-1</sup> in local research trials, which was approximately 26% to 46% higher than the checks. In multilocation trials, fruit yield of Punjab Swarna was recorded to be 2769.59q ha<sup>-1</sup> (Table 1) which was 22% to 43% higher than the checks. Based on the mean performance of 22 on-farm trials, Punjab Swarna out yielded the checks by 15% to 23% (Table 1). Overall, Punjab Swarna recorded an average yield of 2719.15q ha<sup>-1</sup> which was 21% to 40% more than the checks.

Jindal *et al* 2015 and Dhaliwal and Jindal (2018a) also recorded higher early and total yield of tomato hybrids under naturally ventilated polyhouse.

**Physical and biochemical traits of fruits:** Based on the research trials, average fruit weight (Table 2) of Punjab Swarna was 83.42g which was at par with Punjab Sartaj (83.59g); lower than Punjab Gaurav (90.28) and hybrid G-600 (99.69g) but higher than the hybrid Heemshikhar (73.94g). Punjab Swarna produced more number of fruits per cluster and cluster per plant than the check entries which contributes to its significant higher yield. The fruit shape index of Punjab Swarna was more than unity (Table 2) indicating its oval fruit shape. From checks, Punjab Gaurav was also oval in shape but others were comparable in shape index and were round in shape. The pericarp of Punjab Swarna was thicker than both the check hybrids (5.02mm of G-600 and 4.91mm of Heemshikhar) but thinner than Punjab Gaurav (7.42mm) and Punjab Sartaj (7.12mm). The number of locules of Punjab Swarna (2.59) was 7.17%, 26.21%, 33.07% and 30.93% less than Punjab Gaurav (2.79), Punjab Sartaj (3.51), G-600 (3.87) and Heemshikhar (3.75). Thicker pericarp and lesser number of locules are desirable as these are associated with fruit

**Table 2:** Performance of indeterminate tomato varieties/hybrids for fruit and quality traits\* under poly-net house

Traits	Variety/ hybrid	Punjab Swarna	Punjab Gaurav	Punjab Sartaj	Hybrid G-600 (Check)	Hybrid Heemshikhar (Check)	CD at p=0.05%
Days to first harvest		119.98	119.80	116.88	119.13	110.03	1.47
Early yield (q/ha)		415.65	442.85	455.48	516.89	465.89	18.20
Fruit weight (g)		83.42	90.28	83.59	99.69	73.94	2.07
Number of fruit per cluster		9.00	8.67	5.79	5.54	6.40	1.08
Number of clusters per plant		13.34	9.84	12.85	10.65	11.90	0.86
Fruit shape index (P/E)		1.16	1.14	0.94	0.92	0.94	0.05
Pericarp thickness (mm)		5.34	7.42	7.12	5.02	4.91	0.35
Number of locules per fruit		2.59	2.79	3.51	3.87	3.75	0.27
Dry matter (%)		4.42	5.23	5.47	4.29	5.59	0.41
TSS (°Brix)		4.06	5.28	5.44	4.44	4.69	0.34
Acidity (g 100 ml <sup>-1</sup> of juice)		0.42	0.38	0.34	0.30	0.44	0.05
Vitamin C (g 100 ml <sup>-1</sup> of juice)		18.38	23.28	26.24	32.84	29.74	3.02
Lycopene (mg 100 g <sup>-1</sup> FW)		1.35	5.02	5.25	4.21	4.51	0.30
Total carotenoids (mg 100 g <sup>-1</sup> FW)		13.86	5.23	5.02	4.84	4.83	1.16

\*average of 3 years, FW-Fresh weight

**Table 3:** Reaction to important diseases (under artificial inoculation conditions) and insect-pests (under natural conditions)\*

Variety/Hybrid	Late blight, % disease Index	Root gall index, (0- 5 scale)	Leaf curl virus, % incidence	Percent fruit damage by <i>Heliothus armigera</i>	Number of white flies per 50 leaves	Number of aphids per 50 leaves
Punjab Swarna	31.15 (MS)	2.00 (MR)	80.00 (MoI)	17.36	2.52	5.54
Punjab Gaurav (Check)	46.90 (S)	3.10 (MS)	70.00 (MoI)	19.80	1.59	5.92
Punjab Sartaj (Check)	42.75(S)	2.60 (MS)	15.00 (MI)	21.66	2.80	9.50
Hybrid G-600 (Check)	40.50(S)	3.10 (S)	60.00 (SI)	10.50	3.27	14.00
Hybrid Heemshikhar (Check)	43.80(S)	1.55 (MR)	60.00 (MoI)	29.19	2.35	7.79

\*average of 2 years,

Where, S-Susceptible, MS-Moderately susceptible, MR-Moderately Resistant, MoI-Moderate infection, MI-Mild infection and SI-Severe infection

firmness. Jindal *et al* 2015 and Dhaliwal and Jindal (2018a) also observed that the genotype having thicker pericarp has longer shelf life, higher fruit firmness and high transportation ability. All the entries were also evaluated for important fruit quality attributes (Table 2). These included dry matter (DM %), total soluble solids (TSS °Brix), acidity (g 100ml<sup>-1</sup>), vitamin C (g 100ml<sup>-1</sup>), total carotenoids (mg 100g<sup>-1</sup>) and lycopene (mg 100g<sup>-1</sup>). Dry matter % of Punjab Swarna was (4.42) which was more than G-600 (4.29) but lower than Punjab Gaurav (5.23), Punjab Sartaj (5.47) and Heemshikhar (5.59). TSS content of Punjab Swarna (4.06%), was less than the checks. Acidity content of Punjab Swarna was 0.42g ml<sup>-1</sup> which was significantly higher than the Punjab Gaurav, Punjab Sartaj and G-600 however, Vitamin C content (Table 2) and lycopene content of Punjab Swarna (18.38 and 1.35) was less than all the test entries. Punjab Swarna (13.86) had significantly higher total carotenoids (which contributes to its orange colour) than check varieties such as Punjab Gaurav (5.23), Punjab Sartaj (5.02) and also from the check hybrids G-600 (4.84) and Heemshikhar (4.83). The orange colour of ‘Punjab Swarna’ make the fruit more attractive is due to high carotenoid content. Dhaliwal and Jindal (2018a) also developed two cherry tomato varieties with yellow and orange colour having high carotenoids.

**Reaction to diseases and insects:** Punjab Swarna (31.15%) was moderately susceptible to late blight (Table 3) as compared to other check varieties (46.90% Punjab Gaurav and 42.75% Punjab Sartaj) and check hybrids (40.50% G-600 and 43.80% Heemshikhar). The variety Punjab Swarna (2.00) and check hybrid Heemshikhar (1.55) were moderately resistant to root knot nematodes as compare to other checks which were susceptible. Punjab Swarna and other checks except Punjab Sartaj

developed moderate infections to leaf curl disease (Table 3) whereas Punjab Sartaj developed mild tomato leaf curl disease symptoms. The percent fruit damage, number of white flies and number of aphids per 50 leaves were recorded under natural conditions and were found comparable for all the test entries. The variety ‘Punjab Swarna’ is documented with National Bureau of Plant Genetic Resources, New Delhi having accession code ‘IC 624108’.

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