

Pant Popcorn 1

A high yielding hybrid of Popcorn for cultivation

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Popcorn is a special type of flint maize used as a healthy snack. Its demand is increasing due to increasing health consciousness, commercial platforms and activities leading to easy accessibility of popcorn products in different forms. Domestic production of popcorn is however not adequate to support the in-house demands. The popcorn grain is therefore imported to meet domestic demand. In an effort to support domestic popcorn production, a single cross hybrid namely Pant Popcorn 1, combining high grain yield and good popping attributes was released and notified for cultivation in Northern Hill Zone (NHZ) and Peninsular Zone (PZ) based on average grain yield superiority of 34.79% in NHZ and 22.53% in PZ over the check VL Amber popcorn. All these attributes make Pant Popcorn 1, a potential hybrid cultivar for maximizing production and productivity of popcorn.

Keywords: Hill zone, Pant Popcorn 1, Popcorn, Popping

THE high demand for popcorn along with high margin in popcorn business is assumed to be a driving force in choice of crops in Indian agriculture. Traditional corn, popularly known as field corn is used mostly in poultry and starch industries, is deemed unsuitable for popping kernels. The popcorn (*Zea mays* L. *evarta*) is one of the types of maize whose varieties are agronomically trivial and genetically finite as compared to other maize. Popcorn is a small kernelled flint maize with several colours of seeds i.e. white, yellow, red, orange produces puffed flakes of two basic shapes; i) snowflake or butterfly type, which pops big in complicated patterns with many limbs and ii) mushroom type which pops into a round ball shape. Popcorn consumption has boomed over the past decade, especially with the blooming of multiplex cinemas, malls and food courts and Tier-II cities. Consumption in rural areas nearby the cities or semi-rural areas has also increased due to the availability of small packed semi-processed popcorn or popcorn grain

in loose bags at small retailers' shop in small cities. The overall impact has realized in the form of increased demand for popcorn. Based on an estimate, the popcorn market in India is expected to grow at a compound annual growth rate (CAGR) of around 15% during 2018-2022, which is the highest among the any agricultural commodities. Globally, the popcorn market is projected to increase at CAGR of 7.6%. These data indicate a great opportunity for farmers in boosting popcorn production to i) meet the domestic demands and ii) to earn more out of the fast growing business of popcorn. However, domestic production is not adequate to meet the demand for popcorn in the country. The popcorn is cultivated in limited areas in different parts of the country however the exact area, production and productivity of popcorn are currently difficult to predict. The adoption of popcorn cultivation at farmers' level has also not been appreciated in the past because of many reasons including low support price (no separate support price for popcorn),

per unit low grain yield potential in comparison to field corn, susceptibility to biotic and abiotic stresses, non-availability of quality seeds, lack of a specialized marketing channel for popcorn and lack of adequate knowledge about the popcorn at farmers' level. Addressing these issues probably help in increasing in house production and productivity of popcorn. Issues of productivity, adaptability and quality of popcorn are in the domain of network research under All India Coordinated Research Project on Maize and are being addressed from time to time. In this direction, Maize Breeders at Pantnagar has developed a hybrid namely Pant Popcorn 1 which was notified vide notification number S.O. 99 (E) dated 6th January 2020 for cultivation in Northern Hill Zone (Jammu and Kashmir, Himachal Pradesh, Uttarakhand (Hills) and North-Eastern Hill Region (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura) and for Peninsular Zone (Tamil Nadu, Karnataka, Andhra Pradesh,

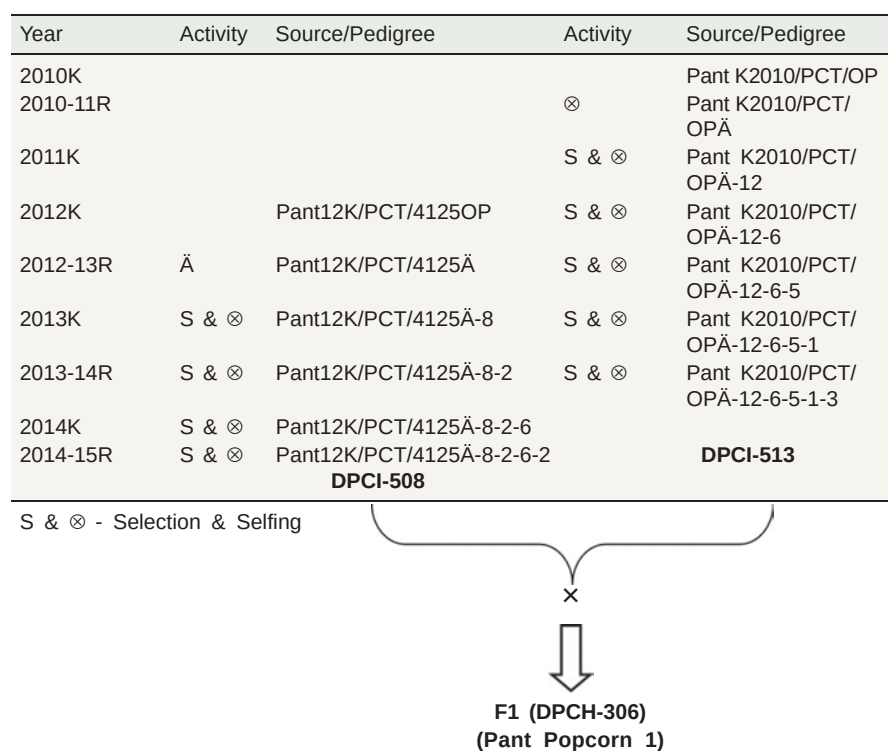


Fig 1. Breeding scheme for development of Pant Popcorn 1

Telangana, Maharashtra). Adoption of Pant Popcorn 1 may help in addressing the issues of productivity of popcorn.

Development of Pant popcorn 1

Pant Popcorn 1 is a single cross hybrid and was developed by crossing the two inbred lines (DPCI-508 and DPCI-513) at Pantnagar. Both the inbred lines were developed using the standard method of selfing followed by selection. The single cross F1 (DPCH-306) developed by crossing inbred lines (DPCI-508 and DPCI-513) was found promising in coordinated trial and thereafter

identified, released and notified for cultivation. The development of inbred lines and hybrid is presented in Fig. 1 and plants and ear views of Pant Popcorn 1 in Fig. 2.

Yield superiority and adaptability

The hybrid Pant Popcorn 1 was tested with the name of DPCH-306 in network trials of All India Coordinated Research projects on Maize for three years from 2016-2018 during the *kharif*. Based on the weighted mean, Pant Popcorn 1 recorded 3657 kg/ha, 3735 kg/ha and 4261 kg/ha grain yield during the

year 2016, 2017 and 2018 and established 13.4, 25.8 and 53.6 % superiority over the check VL Amber popcorn which recorded 3,226, 2,969 and 2,774 kg/ha grain yield, respectively in Northern Hill Zone (Table 1). On an overall basis, Pant Popcorn 1 had grain yield of 3,975 kg/ha which was 34.8% higher than the average grain yield of 2,949 kg/ha VL Amber Popcorn. Out of the 10 locations of testing, Pant Popcorn 1 occupied in first non-significant group 8 times whereas the check VL Amber popcorn only once. The data therefore clearly established the superiority of Pant Popcorn 1 over the VL Amber Popcorn in Northern Hill Zone.

In Peninsular Zone, grain yield of Pant Popcorn 1 was 4,169, 4,836 and 5,584 kg/ha with grain yield advantage of 35.3, 30.67 and 13.4 % against the grain yield levels of 3,082, 3,701 and 4924 kg/ha of check VL Amber popcorn during the year 2016, 2017 and 2018, respectively (Table 1). On the basis of three years average, Pant Popcorn 1 established 22.5% yield advantage with grain yield of 4997 kg/ha over the grain yield of 4078 kg/ha of VL Amber popcorn. In Peninsular Zone, Pant Popcorn 1 appeared 13 times in first non-significant group against 3 times of the check VL Amber Popcorn out of the total testing locations of 21 during the three years of testing.

Popping attributes of Pant Popcorn 1

The parameters taken into account to test the popping quality of the



Fig 2. Crop and ears of Pant Popcorn 1

Table 1. Grain yield of Pant Popcorn 1 with the check VL Amber Popcorn in NHZ and PZ

Zone	Year & season of testing	Pant Popcorn 1	VL Amber Popcorn (C)
Northern Hill Zone (NHZ) Grain yield (Kg/ha)	2016K*	3,657	3226
	2017K	3735	2969
	2018K	4261	2774
		3975	2949
Weighted Mean (Kg/ha)			2949
% increase over check	2016K		+13.36
	2017K		+25.80
	2018K		+53.60
Overall % superiority			+34.79
Frequency in top group		8/10	1/10
Peninsular Zone (PZ) Grain Yield (Kg/ha)	2016K	4169	3082
	2017K	4836	3701
	2018K	5584	4924
		4997	4078
Weighted Mean (Kg/ha)			4078
% increase over check	2016K		+35.32
	2017K		+30.67
	2018K		+13.40
Overall % superiority			+22.53
Frequency in top group		13/21	3/21

*K-kharif season

hybrid Pant Popcorn 1 were popping percent, volume before popping, volume after popping and 100-kernels weight (Table 2). Pant Popcorn 1 had an average of 89% popping as compared to average of 91% in VL Amber popcorn over the three years. The average volume before and after popping for Pant Popcorn 1 was 20 and 250.5 ml/cm³, respectively, whereas in case VL Amber Popcorn, the same were 17.5 and 250 ml/cm³. The 100-kernel weight of Pant Popcorn 1 was 16.5 g while VL Amber Popcorn had average kernel weight of 16g.

Table 2. Popping quality parameters of Pant Popcorn 1

Quality parameters	Year of Testing	Pant Popcorn 1	VL Amber popcorn (C)
Popping percent (%)	2016	90	89
	2017	86	90
	2018	91	94
Mean		89	91
Vol. before popping (ml/cm ³)	2016	21	20
	2017	19	15
	2018	-	-
Mean		20	17.5
Vol. after popping (ml/cm ³)	2016	222	204
	2017	279	296
	2018	-	-
Mean		250.5	250
100-kernes weight (g)	2016	15	16
	2017	18	16
	2018	-	-
Mean		16.5	16

Reaction to major diseases and insect pest

The hybrid Pant Popcorn 1 was tested for the response against prevalent major diseases of the zones under the artificial epiphytotic condition in both NHZ and PZ (Table 3). Pant Popcorn 1 showed a higher level of tolerance to Maydis leaf blight (MLB), Turicum leaf blight (TLB), Bacterial stalk rot, banded leaf and sheath blight (BLSB) and Curvularia leaf spot (CLS) when compared to susceptible check. Response of Pant Popcorn 1 for referred diseases was either *at par* or better to check variety VL Amber Popcorn and resistant check.

In PZ, Pant Popcorn 1 showed much lower disease incidence for TLB, Charcoal rot common rust (CR), polysora rust (PR) when compared with susceptible check.

Table 3. Average score of the major diseases and insect in NHZ and PZ during 2016-18 Kharif

Zone	Disease/Insect	Pant Popcorn 1	VL Amber popcorn	Susceptible Check	Resistant Check
NHZ	MLB (1-9)	2.0	2.0	3.5	3.5
	TLB (1-9)	4.4	5.1	6.0	3.3
	Bacterial Stalk Rot (%)	32.8	32.4	59.4	28.5
	BLSB (1-9)	3.0	3.5	6.5	-
	CLS (1-9)	2.0	2.0	2.8	2.8
PZ	TLB (1-9)	6.4	7.4	8.2	3.2
	Charcoal rot (1-9)	4.9	4.7	6.7	1.6
	CR (1-9)	5.3	5.5	7.1	4.3
	PR (1-9)	3.3	2.5	5.0	3.7
	<i>Chilo partellus</i> (1-9)	6.1	5.7		

Pant Popcorn 1 had also better response against TLB when compared with the check VL Amber Popcorn whereas for other diseases, by and large both had *at par* reactions. *Chilo partellus* reactions of Pant popcorn 1 and check variety VL Amber Popcorn was also comparable.

Distinguishing morphological characters

In NHZ, Pant Popcorn 1 took an average of 54.1, 57.2 and 99.3 days over the three years in days to 50% anthesis, days to 50% silking and days to 75% dry husk while the check VL Amber popcorn took 54.6, 57.9 and 99.97 days, respectively. Mean plant height (184.7 cm) and mean ear height (92.2 cm) was more than the plant and ear height of 163.9 and 84.5 cm of VL Amber popcorn. In PZ, Pant Popcorn 1 took 50.7, 53 and 90.5 days in days to 50% anthesis, days to 50% silking and days to 75% dry husk while the same was 51.2, 53.7 and 89.5 days, respectively for the check VL Amber Popcorn. The mean plant height (167.6 cm) and mean ear height (80.1cm) were higher than the plant height of 162.3 cm and ear height of 77.8 cm of VL Amber Popcorn. Plants of the Pant Popcorn 1 are sturdy bearing longer ear with yellow-orange kernels.

Agronomic practices

During the course of development of variety, agronomical practices found appropriate for Pant popcorn 1 cultivation has been described (Table 4). Farmers are advised to get their soil and water tested for better management of nutrients and irrigation. This is important for minimizing the input cost and utilizing the available nutrients

Table 4. Agronomic practices for Pant Popcorn 1

Particulars	Details
Recommended area	Northern Hill Zone (Zone I)- [Uttarakhand (Hills), Himachal Pradesh, Jammu & Kashmir and North East hills. Peninsular Zone (Zone IV): Andhra Pradesh, Telangana, Karnataka, Maharashtra, Tamil Nadu
Sowing time	15 June to 15 July (it may vary depending on the altitude and onset of monsoon, in plain area, Pant Popcorn 1 can be cultivated in winter/spring season)
Seed rate	10-12 kg/ha, Line sowing with row to row spacing 60 cm and plant to plant spacing 20 cm. Seed treatment is essential to protect crop from Fall Army Worm initially few days after germination
Fertilizer doses	Apply 10 ton of FYM/ha. Nitrogen 100-120 kg in split doses, 60 kg of Phosphorus, 40 kg of potash and 25 kg of zinc sulphate/ha should be applied at the time of sowing as basal dose.
Weed control	Spray of pre-emergence herbicide atrazine 50 WP @ 1.0 kg ai /ha (i.e. 2.0 kg/ha) just after sowing or within four days of sowing. Hand/hoe weeding in 20-30 days crop, if required, followed by earthing. Tembotrione 42% SC @ 120 g a.i./ha (i.e. 286 ml/ha) at 20-22 days after sowing as post emergence.
Major disease and pest control	Fall Army Worm (FAW) has now become a serious pest of maize. Its control can be done initially by seed treatment and later on by use of i) Spinetoram 11.7% SC @ 0.4 ml/L, or ii) Chlorantraniliprole @ 0.4ml/L, or Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC @ 0.25 ml/L. Proper monitoring of field after sowing and advice from the concerned scientist/expert/extension scientists when a symptom appears are advised for efficient use of combination of control measures.
Irrigation	Generally irrigation is not required when cultivated in <i>kharif</i> , however in case of any drought spell, irrigation requires to be provided. When crop is grown in <i>rabi</i> /spring season, regular irrigation is required.
Harvesting	Harvesting is done when ear husks turn yellow. After harvesting ears are dried well. After shelling, grains are dried well since popping quality is influenced by the moisture content of the grain. Low moisture of grains also helps in healthy and long term storage of popcorn.
Expected yield	35-40 q/ha

present in the soil. Timely consultation with the scientists along with the recommended package of practices is always rewarding.

SUMMARY

Based on high yield performance, popping quality and resistance to diseases, Pant Popcorn 1 was identified by a Varietal Identification Committee in 62nd Annual Maize Workshop held at Assam Agricultural University Jorhat (Assam) and released and notified by the Central Sub- Committee on Crop Standards, Notification and Release of Varieties of Agricultural Crops for cultivation in NHZ and PZ. Pant Popcorn 1 was tested in AICRP maize trials in *kharif*. However, it has also shown better adaptation, high grain yield and even better kernel quality when the crop was cultivated in *rabi* and spring season at Pantnagar. So its cultivation can also be extended in *rabi* and spring season when irrigation facility is available. Being a high yielding along with good popping attributes, Pant Popcorn 1 may prove to be a potential crop for farmers for maximizing returns from maize cultivation.

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