

Suitability of Induced Flowering in Potato under Short Day Conditions

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In potato varietal improvement programme, availability of ample flowers at proper time with functional male and female parts is an indispensable requirement for hybridization to achieve true potato seed (TPS). Genotype, day-length and temperature are main factors, which determine the flowering and fruiting in potatoes [1, 2, 3]. Though flower primordia of potato can arise in total darkness, a photoperiod of 14-18 hours and night temperature of 15 to 20°C favour flower production and berry setting [1]. In tropics and sub-tropics, conditions conducive to flowering and fruiting are available only at high altitudes (>1500m above sea level) where crop is grown during summer season. Under short day conditions, flowering in potato is achieved through extended photoperiod and additional hormonal application further enhances the flowering intensity, flowering duration and advances the flowering as well [4, 5]. However hormonal induced flowering reduces flower vigour and size [5] and in some genotypes abnormal flowers are obtained leading to pollen sterility [6]. The present investigation was thus conducted to study the suitability of induced flowering genotypes as male or female parents in varietal improvement programme based on pollen quantity/fertility in 10 genotypes and hybridization success in 12 crosses. The experiments were conducted during autumn seasons of 1994-1995 and 1995-1996 at Central Potato Research Institute Campus, Modipuram, Meerut.

Sixteen tubers each of 10 genotypes were planted in two rows (8 tubers/row) at 60 x 25 cm spacing under short day conditions. For creating artificial long day conditions (LD), additional lights through sodium vapour lamps (250w) was provided for 6 hours during evening hours. One row of each

genotype was sprayed with hormonal combination (GA 50ppm + IBA 10 ppm + Kinetin 2ppm) as suggested by Khan *et al.* [5] to create LD+H conditions. In all three spray of hormonal application starting from bud initiation were given at a week interval. Normal manurial and cultural schedule were followed for raising the crop. At flowering, the pollen was collected from 10 freshly opened flowers from each genotype under both the environment and quantity of pollen was quantified on an arbitrary scale of 0-5 scale; 0-no pollen, 1-very less pollen, 2-less pollen, 3-moderate pollen, 4-good pollen and 5-abundant pollen. Anthers from three well-developed flowers from each genotype under both environments were subjected for pollen fertility studies by squashing them in 2% aceto-carmin solution. Temporary preparations were used for studying pollen stainability under microscope. The data on pollen fertility was recorded in at least 20 microscopic fields. Regular shaped stained pollen grains were classified as fertile and irregular shaped, empty, shrunken and unstained pollen grains as sterile. For working out hybridization success, 12 female parents grown during 1995-1996 crop season under LD and LD+H conditions were pollinated using highly fertile pollen of male parents grown under LD conditions. The data was recorded on buds pollinated, berries formed, berry weight, TPS obtained and TPS/berry.

Pollen quantity was reduced (3.15) by 24% under LD+H conditions (3.15) than LD (4.2) conditions except in genotypes CP3197 and MS/82-828, which produced moderate and abundant pollen respectively under both the conditions over both years (Table 1). Pollen fertility under LD+H conditions was low (39%) than LD conditions (65%).

Table 1. Pollen quantity and pollen fertility in potato genotypes under LD (extended photoperiod) and LD+H (LD + hormonal application) conditions.

Genotypes	Pollen quantity*						Pollen fertility (%)					
	LD			LD+H			LD			LD+H		
	1994-95	1995-96	Mean	1994-95	1995-96	Mean	1994-95	1995-96	Mean	1994-95	1995-96	Mean
CP2366	5	5	5.0	4	3	3.5	76.69	70.64	73.66	67.77	50.00	58.88
CP3197	3	3	3.0	3	3	3.0	61.86	70.83	66.34	49.69	60.16	54.92
CP3204	5	5	5.0	5	4	4.5	77.67	82.25	79.96	76.52	67.28	71.90
CP3208	4	4	4.0	1	1	1.0	24.74	71.27	47.95	00.00	00.00	00.00
J11857	3	3	3.0	2	1	1.5	60.82	55.55	58.18	00.00	12.00	06.00
MS/80-758	4	4	4.0	3	4	3.5	40.49	63.00	51.74	20.60	57.64	39.12
MS/81-119	5	5	5.0	5	4	4.5	56.16	73.15	64.65	33.42	69.13	51.27
MS/82-797	5	4	4.5	3	4	3.5	64.51	63.28	63.89	17.07	48.48	32.77
MS/82-828	5	5	5.0	5	5	5.0	84.31	84.00	84.15	64.11	77.94	71.02
MS/82-864	3	4	3.5	2	1	1.5	62.89	53.68	58.28	14.51	00.00	7.25
Mean	4.2	4.2	4.2	3.3	3	3.15	61.01	68.77	64.88	34.37	44.26	39.31

*Scale: Pollen quantity on 0-5 scale; 0-no pollen, 1- very less pollen, 2-less pollen, 3-moderate pollen, 4-good pollen and 5-abundant pollen.

Table 2. Hybridization success in potato under LD (extended photoperiod) and LD+H (LD + hormonal application) conditions.

Crosses	Buds pollinated		Berries formed		Berry weight(g)		TPS Obtained		TPS/berry			
	Number		Percentage									
	LD	LD+H	LD	LD+H	LD	LD+H	LD	LD+H	LD	LD+H		
CP2332 x MS/86-84	24	140	7	28	29.16	20.00	4.28	2.86	600	1200	86	43
CP3197 x MS/86-84	55	136	11	15	20.00	11.02	6.36	6.67	800	800	73	53
CP3204 x CP3192	130	232	16	45	12.30	19.39	12.5	8.11	2850	6450	178	143
Kufri Lauvkar x CP3192	8	173	4	58	50.00	33.52	10.5	8.39	700	8200	175	141
MS/82-797 x CP3205	72	112	43	41	59.72	36.60	11.16	8.41	6800	4100	159	100
MS/84-864 x CP3197	61	159	15	40	24.59	25.16	9.06	6.57	2750	3250	183	81
MS/87- 1192 x CP3192	80	167	48	86	60.00	51.50	8.42	4.65	6400	7000	133	81
MS/89-1095 x CP3205	211	140	99	56	46.92	40.00	10.86	8.12	12400	4800	125	86
MS/89-163 x CP3197	45	168	9	64	20.00	38.09	7.33	5.86	400	3900	44	61
MS/89-586 x CP3205	39	192	25	62	64.10	32.29	13.08	9.43	3400	4100	136	66
PH/F-1045 x JEX/A-319	50	99	22	23	44.00	23.23	7.14	7.69	2000	3000	91	130
CP2332 x JEX/A-319	82	114	32	36	39.02	31.57	6.81	4.86	3300	3200	103	89
Mean	71	152.67	27.58	46.17	39.15	30.20	8.96	6.80	3533	4167	123.83	89.50

One genotype-CP3208 did not produce any stainable pollen in both the years. However, J11857 and MS/82-864 did not produce stainable pollen in one year and pollen stainability was quite low in another year under LD+H conditions as compared to LD conditions. Gopal and Rana [6] also found pollen

sterility in hormonal induced flowers; they attributed it to prevailing less humidity during flowering under short day conditions.

The reduction in pollen quantity and pollen fertility or induction of pollen sterility may also be due to physiological changes occurring after

hormonal application as in some genotypes, flower vigour and size was reduced, and even other flower abnormalities like malformation of inflorescence/ flower buds/ anthers/ stigma, fusion of anthers with style and faint flower colour were also observed. The present results indicated non-suitability of hormonal induced flowers as male parents because availability and fertility of pollen parent have direct relation with the number of successful hybridization [7].

The hybridization in 12 female parents grown under LD+H conditions using pollen of male parents grown under LD conditions revealed 23, 24 and 28% reduction in berry setting, mean berry weight and TPS/berry respectively than LD grown 12 female parents pollinated with LD grown male parents (Table 2). However, more than double (2.14 times) flower buds were available in female parents under LD+H conditions as compared to LD conditions for undertaking hybridization. As a result, about 49% more berries were obtained under LD+H conditions as compared to LD conditions, resulting in recovery of more true potato seed in most of the crosses attempted.

Though pollen quantity, pollen fertility, berry setting, berry weight, and TPS/berry were reduced in LD+H conditions but enhanced flowering and flowering in hard to bloom potato genotypes offers significance of hormonal induced flowering in hybridization for varietal improvement programme under short day conditions. In potato, male sterility limits the use of genotype as male parents but at the same time this is advantageous because male sterile genotypes when used as females in controlled pollination do not require emasculation [3]. The use of male sterile potato genotype reduces the cost of

true potato seed production as well, because of elimination of laborious job of emasculation.

The present studies revealed that female parents can be grown under LD-H conditions for achieving more flowers available for hybridization but male parents should be grown under extended photoperiod conditions alone for more pollen quantity and high pollen fertility for successful hybridization programme under short day conditions of west-central plains.

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