CLONAL EVALUATION OF POPLAR (*POPULUS DELTOIDES* BARTR.) IN EASTERN UTTAR PRADESH. I - NURSERY TESTING

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Introduction

Populus deltoides is a fast growing exotic species, which is being grown as pure or in mixed plantation under different Agro-forestry systems on Indo-Gangetic plains North of 28°N Latitude. It is needless to emphasize the myriad uses of Poplar in paper and pulp, plywood, veneer, matchwood, packing cases and light timber. Poplar cultivation is well adapted in Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir and Western Uttar Pradesh. However, encouraging results were also found in the nursery and field trial on Poplar in the eastern Indo-Gangetic region (Anon., 1994; Dixit *et al.*, 1994; Singh *et al.*, 1999). The problem of bark splitting, necrosis and canker formation was noticed on some trees of few clones which can be solved by selecting the site matched clones through multi-locational testing of promising clones and adoptation of cultural practices (Kumar *et al., 1999).*

There are various reports available on the comparative performance of clones from nursery studies to the field trials (Singh and Beniwal, 1989; Sagwal, 1985, 1991; Sidhu, 1994, 1996; Mishra *et al.,* 1995; *Singh and Negi, 1996). In order to extend* Poplar cultivation to the lower latitude upto 25° N in the northern plains, promising clones developed by U.P. Forest Department, WIMCO Ltd. and Dr. Y.S. Parmar University of Horticulture and Forestry as well as clones of USA origin were collected for nursery and field trial (Singh *et al.*, 1999).

Pryor and Willing (1965) also suggested that new clones or introduction of new germplasm from southern-most parts of USA should be tested for the development of Poplar clones suitable to low latitudes. Clones from University of Horticulture & Forestry, Solan (H.P.), were developed from recent collection of germplasm of southern most parts of USA.

Populus deltoides is widely planted in Western Uttar Pradesh upto Shahjahanpur and 90 % plantation is based on G48, *G3, D121, S7C15, L-34* and *L-200.* These clones have narrow genetic base which may yield high productivity but leads to dangerous and unproductive stage in long term under continued plantations (Libby, 1982; Sidhu, 1996 ; Singh *et al.*, 1999). Once the clone G3 was widely planted in

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North India now it has become gradually susceptible to number of diseases and pests. The growth performance of different American clones was worked out on the basis of experimental plantation of State Forest Deptt. (age 5 years) in Haldwani Forest Division, Nainital (Uttaranchal). G3 was ranked at 57 number where as G48 could retain fourth position (Kumar *et al.*, 1999). There are different opinions on the number of clones to be used for clonal forestry. Libby (1982) is in favour of 7 to 25 clones where as Rauter (1983) suggested 30 to 120 clones per plantation. Zsuffa (1983) recommended the replacement of 5 to 10 % clones in field trial every year though newly evolved high yielding clones.

The results of first hand introduction trial on Poplar clones at National Botanical Research Institute, Lucknow, hold the promise to further extend an intensive screening of newer clones in Eastern-Gangetic plains for good soil as well as partly degraded lands having assured irrigation facilities (Singh, 1998a, b). Similar experiments were conducted in China to screen the site matched clones for flooding areas and drought resistance (Cao and Conner, 1999; Zheng *et al.*, 1991). Yadav and Prakash (1995) laid out an experiment on three clones namely G3, G48 and D121 under various levels of salinity and sodicity. The findings of experiment revealed that none of the clones could survive in salinity conditions. However, in sodicity treatment, all the three clones survived upto pH 8.75 (ESP-20). It again encourages to undertake the clonal trials with larger number of clones for selecting the extreme genotypes.

With view to the importance of genotype and environment interaction specially in non-traditional growing areas of Poplar, the present study has been undertaken with collaboration of Indian Farm Forestry Development Cooperative (I.F.F.D.C.) at Sultanpur (U.P.).

Material and Methods

Site Details : The experiment was conducted at Ramshahpur village, I.F.F.D.C. Ltd. nursery, in the District of Sultanpur of Uttar Pradesh. The area lies between 26° 16' N latitude and 82° 07' E longitude. The climate of the area is semi-arid tropical. Mean maximum and minimum temperature are 43° C and 3° C respectively. Mean annual rainfall is 1000mm which is mostly received during July, August and September. Winter rains are scanty and irregular. Soil is highly sodic and pH varies between 9.9 and 10.2. Sodium is the dominant cation at the soil exchange complex and therefore, the exchangeable sodium and the nutrient status is impoverished and imbalanced (Table 1). The available phosphorus is less than 5.5 ppm throughout the profile. The soil is light grey to pale yellow in colour and fine loamy to coarse loamy in texture. It is characterised by dry hard, sub-angular blocky ochric epipedon overlying very firm, strong sub-angular blocky natric horizon (Table 2). The petrocalcic layer is 35 cm thick at a depth of 93cm and is wet sticky due to hign water table. Occurrence of yellow distinct mottles below 33 cm depth and presence of manganese nodules further indicate fluctuations of the high water table. The nursery soil was treated by mixing imported soil, sand, FYM, gypsum, zinc sulphate and inorganic fertilizers as per recommendation of Forest Soil and Land Reclamation Division, F.R.I., Dehra Dun (soil amendment comprises Soil, Sand, FYM in the ratio of 3:1:1, Foret-10G - 50 gm; Gypsum - 6kg; Zinc Sulphate - 200 gm, Single Super Phosphate (SSP) 1600 gm;

Table 1

Physico-Chemical properties of study sites

Properties	Horizon				
	Ap	B21	B22	B23	Cca
Depth (cm)	0-11	11-32	32-60	60-93	93-128
Sand (%)	58	49	51	50	55
Silt (%)	32	35	27	29	31
Clay (%)	10	16	22	21	14
Texture	SL	L	SCL	L	SL
PH	10.2	10.1	10.2	9.9	9.9
EC (dS/m)	1.8	1.2	1.2	1.0	1.0
Water Soluble Salt %	0.48	0.56	0.62	1.00	0.98
Free $CaCO_3$ (%)	8.8	9.2	8.5	9.0	9.4
Base Saturation (%)	70.8	73.8	56.1	56.8	74.4
C.E.C (m.e.%)	20.2	20.6	19.8	16.9	9.8
Exchangeable Ca (m.e.%)	2.2	2.3	1.9	1.2	0.9
Exchangeable Mg (m.e.%)	1.0	1.2	0.6	0.4	0.3
Exchangeable K (m.e.%)	0.4	0.5	0.3	0.2	0.1
Exchangeable Na (m.e.%)	10.7	11.2	8.3	7.8	5.4
Exchangeable Na (%)	52.9	54.4	41.9	46.1	55.1
Organic Carbon (%)	0.13	0.07	0.03	0.02	0.02
Total N (%)	0.0125	0.0040	0.0035	0.0020	0.0015
Available P (ppm)	5.2	4.5	0.04	2.9	1.6
Available K (ppm)	85	72	70	21	12

Table 2

Morphology of the soil profile

Horizon	Depth (cm)	Colour	Structure	Consis-tency	Boundary	Others Features
Ap	0-11	2.5Y 6/2	m2 sbk	dh	cs	
B21	11-32	2.5Y 7/2	m2 sbk	mvfi	ds	
B22	32-60	2.5Y 6/2	c3 sbk	mvfi	ds	Few faint yellow mottles
B23	60-93	2.5Y 7/4	m2 sbk	mfi	aw	Many distinct yellow mottles
Cca	93-128	2.5Y 7/2	f1 sbk	ws		Hard Calcic layer with plenty of $CaCO_3$ nodules

Urea - 400 gm; Muriate of Potash (MOP) - 200gm per bed). The treated soil has a pH of 8.2 and ESP 15. One hundred beds of 11m x 1m x 0.5 m size were prepared and the cuttings of 23 cm in length and 1.5-2cm in diameter of 75 promising clones (60 cuttings per clones) were planted in 4th week of January 1998 in Complete Randomized Block Design with four replications (15 cuttings/replication) in the spacement of 80 cm x 60 cm. The cuttings were treated with fungicide and insecticide as per package of practice for raising Poplar nursery. Uniform irrigation, weeding and other cultural practices were given to the experimental trial. Observations on survival, collar diameter, plant height etc. were recorded in December 1998 and statistically analyzed as suggested by Panse and Sukhatme (1989).

Results and Discussion

The perusal of Table 3 reveals that analysis of variance on clones under study differ significantly among themselves for survival percentage, plant height, collar diameter and internodal length in nursery stage at the age of one year. The survival percentage varied from 46.09 to 99.85. S7C8, G3, 43-N and 126/86 showed highest survival percentage (99.85) followed by 9 clones namely S7C15, 23-N, 38-N, 40-N, UD-9020, PD-1, 90-12 and L-200 exhibited more than 99%. Minimum survival percentage (46.09) was recorded in 113520 followed by S4C21 (50%) and 3324 (71.66%). The variation in plant height was quite interesting and it was observed from 265.02 cm to 588.49 cm. UD-6502 registered maximum plant height (588.49 cm) closely followed by UD-4707 (565.41 cm), UD-36 (562.78 cm) and 40-N (558.83 cm). Minimum plant height (265.02 cm) was attained by WSL-45.

Collar Diameter varied from 1.59 cm to 3.67 cm and PD-1 gave highest value (3.67 cm) closely followed by UD-1009 (3.64 cm), UD-4707 (3.60 cm) and UD-1003 (3.58 cm) whereas lowest 1.59 cm value was found in WSL-45.

Internodal length differs from 4.37 to 7.56 cm. Maximum internodal length (7.56 cm) was noticed in UD-88 followed by UD-55 (7.40cm), 82-26-5 (7.35 cm) and 41-N (7.24 cm). Minimum value (4.37 cm) was found in S4C21.

The growth data for all four characters were subjected for computation to see the inter relationship between different growth parameters. Out of six correlation coefficient in the present study, all characters are positively correlated except collar diameter and internodal length.

In order to judge the relative performance of 75 different promising clones, G3, G48, D121 and Udai were treated as check (control) clones. Independent culling method of selection was used to mark better performer clones. Lowest limit for survival percentage, plant height, collar diameter and internodal length was fixed 85%, 500 cm, 3.0 cm and 5.0 cm respectively. Based on the present criteria of selection 11 clones were qualified and out of these superior performers, 3 clones (D121, D124, 82-26-5) are old American ones. The remaining 8 clones namely 34-N, 40-N, 25-N, UD-36, UD-5502, 90-12, UD-6502 and UD-4707 were developed at Dr. Y.S.Parmar University of Horticulture and Forestry, Solan (H.P.), which were brought under nursery screening followed by field testing first time in Eastern Uttar Pradesh. Five clones (UD-4707, UD-6502, 40-N, 34-N and 36-N) were assessed top ranking clones in descending order and none of the well

Table 3

Nursery Performance of Poplar clones (Populus deltoides) at IFFDC Ltd. Sultanpur (U.P.)

Clone	Source	Origin	Survival (%)	Plant Height (cm)	Collar Diameter (cm)	Inter-nodal Length (cm)
1	2	3	4	5	6	7
S7C20	Brazos, Texas	USA	94.52 (9.72)	373.35	1.95	6.26
S4C2	-- do --	USA	95.61 (9.77)	404.70	2.38	5.12
S7C15	-- do --	USA	99.62 (9.88)	423.12	2.50	5.45
S7C8	-- do --	USA	99.85 (9.99)	463.93	2.73	5.18
S4C21	Liberty, Texas	USA	50.00 (7.06)	306.00	1.62	4.37
S7C7	Brazos, Texas	USA	97.34 (9.86)	385.12	2.64	4.95
S13C11	Bowie, Texas	USA	92.00 (9.59)	425.00	2.49	5.42
S7C2	Brazos, Texas	USA	94.28 (9.70)	331.83	1.82	6.06
S7C1	-- do --	USA	95.50 (9.77)	454.94	2.49	6.40
D121	Washington, MS	USA	92.52 (9.61)	526.96	3.06	6.27
D82	Issaquena, MS	USA	90.72 (9.52)	437.18	2.72	4.95
D75	-- do --	USA	91.15 (9.54)	416.66	2.65	5.08
D74	-- do --	USA	81.20 (9.01)	411.66	2.78	4.83
D171	Coahoma, MS	USA	79.51 (8.91)	357.65	2.45	5.16
D124	Issaquena, MS	USA	94.25 (9.70)	503.51	3.32	5.91
G48	Australia	Brazos, Texas USA	87.26 (9.34)	369.17	2.25	5.73
G3	-- do --	-- do --	99.85 (9.99)	371.69	2.78	4.83
3324	Baton Rough, LA	USA	71.66 (8.46)	266.32	1.97	4.66
421-2	St. Landry, LA	USA	89.31 (9.45)	491.04	2.76	5.07
82-42-5	Victoria, Texas	USA	96.18 (9.80)	267.13	1.88	6.20
82-26-5	Dallas, Texas	USA	93.31 (9.65)	532.48	3.30	7.35
82-33-3	Liano, Texas	USA	95.50 (9.77)	332.90	2.19	5.05
82-35-4	Brazos, Texas	USA	96.04 (9.79)	338.34	2.47	4.62
82-40-2	Victoria, Texas	USA	80.61 (8.97)	423.61	2.94	4.50
113324	Louisiana	USA	88.60 (9.41)	397.49	2.76	4.83
113520	MS	USA	46.09 (6.78)	297.85	2.20	5.16
110702	Bolivar, MS	USA	88.66 (9.41)	458.47	3.26	4.71
UD-8806 (88)	UHF, Solan	MS, USA	95.22 (9.75)	384.10	2.30	7.56
UD-55	UHF, Solan	LA, USA	98.50 (9.92)	463.75	2.58	7.40

Contd...

1	2	3	4	5	6	7
42-N	Solan	USA	93.18 (9.65)	458.63	2.71	5.80
23-N	-- do --	-- do --	99.62 (9.98)	403.09	2.34	5.98
41-N	-- do --	-- do --	99.75 (9.98)	433.87	2.42	7.24
37-N	-- do --	-- do --	89.35 (9.45)	393.26	2.11	5.27
38-N	-- do --	-- do --	99.66 (9.98)	438.75	2.12	6.28
34-N	-- do --	-- do --	93.93 (9.69)	550.16	3.19	5.84
40-N	-- do --	-- do --	99.69 (9.98)	558.83	3.54	6.14
25-N	-- do --	-- do --	95.70 (9.78)	538.31	3.54	5.30
63-N	-- do --	-- do --	89.97 (9.48)	515.46	2.91	5.91
36-N	-- do --	-- do --	97.38 (9.86)	477.80	2.84	5.94
43-N	-- do --	-- do --	99.85 (9.99)	458.68	2.70	5.83
26-N	-- do --	-- do --	95.99 (9.79)	439.63	2.67	6.07
39-N	-- do --	-- do --	79.76 (8.93)	429.16	3.23	5.29
UD-7	Solan	Texas, USA	94.18 (9.70)	465.09	2.74	6.12
126/86	Solan	Haldwani	99.85 (9.99)	456.66	2.73	6.15
UD-9605 (96-5)	-- do --	MS USA	88.35 (9.39)	439.97	2.67	7.13
UDH-1001 (Solan-1)	-- do --	Hybrid material	96.10 (9.80)	451.18	2.66	6.04
UDH-1002 (Solan 2)	-- do --	-- do --	96.03 (9.79)	415.29	2.44	6.04
22/86	-- do --	Haldwani	90.72 (9.52)	483.00	2.98	5.93
UD-9116 (T_1-6(91))	-- do --	MS, USA	95.43 (9.76)	362.60	2.43	6.28
UD-9020 (UDT-90)	-- do --	-- do --	99.72 (9.98)	444.77	2.99	6.49
UD-902 (9-2)	-- do --	Texas, USA	94.07 (9.69)	460.22	2.77	5.33
UD-10009 (100-9)	-- do --	MS, USA	89.92 (9.48)	499.99	3.64	5.40
UD- 10005 (100-5)	-- do --	-- do --	94.03 (9.09)	362.60	2.44	5.23
UD-36 (# 36)	-- do --	Texas, USA	86.59 (9.30)	562.78	3.12	6.13
UD-5502 (55-2)	-- do --	LA, USA	97.83 (9.89)	510.07	3.05	6.12

Contd...

1	2	3	4	5	6	7
PD-1	-- do --	Seedling material (Local Selection)	99.62 (9.98)	506.63	3.67	4.76
90-12	Solan	MS, USA	99.72 (9.98)	510.67	3.14	6.06
UD-6500	-- do --	LA, USA	96.28 (9.81)	404.96	2.46	7.02
UD-6502	-- do --	-- do --	88.10 (9.38)	588.49	3.35	6.06
UD-4709 (47-9)	-- do --	Brazos, MS, USA	97.62 (9.88)	390.68	2.83	5.24
RD-01	-- do --	Local Selection	87.94 (9.37)	455.68	3.01	5.16
UD-1003 (103)	-- do --	USA	97.42 (9.87)	474.25	3.58	5.08
UD-4707 (47-7)	-- do --	-- do --	98.25 (9.91)	565.41	3.60	5.50
UD- 10007 (100-7)	-- do --	-- do --	74.73 (8.64)	486.75	3.20	4.66
UD-98 (98)	-- do --	-- do --	90.97 (9.53)	493.58	2.82	4.58
A-13	Clarke, Alabama	USA	90.97 (9.53)	311.96	2.21	5.16
WSL-45	WIMCO, Rudrapur	Local Selection	92.32 (7.43)	265.02	1.59	6.17
Kranti	-- do --	-- do --	92.28 (9.60)	455.33	3.55	6.15
Bahar	-- do --	-- do --	93.94 (9.89)	416.01	2.39	5.74
Udai	-- do --	-- do --	82.15 (9.06)	515.62	3.16	5.16
L-200/84	Haldwani	Local Selection of open pollinated seedling	99.62 (9.98)	413.58	2.67	5.71
L-34/82	-- do --	-- do --	97.50 (9.87)	420.43	2.58	5.69
L-49/82	-- do --	-- do --	89.43 (9.45)	443.58	2.57	5.80
L-62/84	-- do --	-- do --	88.41 (9.40)	366.25	2.38	5.66
L-188/84	-- do --	-- do --	93.88 (9.68)	330.11	1.81	5.17
Mean ± SE			91.76 (9.57±0.95)	432.54 ± 27.79	2.70 ± 0.19	5.66 ±0.35
Range			46.09-99.85 (6.78-9.99)	265.02-588.49	1.59-3.67	4.50-7.56
C.V.			1.41	9.08	10.33	8.93
C.D. (at 5%)			1.87	54.47	0.38	0.70

Table 4

Simple Linear Correlation coefficient between different pairs of characters

Character	X1	X2	X3	X4
X1	-			
X2	0.772*	-		
X3	0.262*	0.177^{NS}	-	
X4	0.142	-0.059^{NS}	0.333*	-

X1 - Plant Height; X2 - Collar Diameter;
X3 - Survival percentage; X4 - Internodal Length.
* - at 5% level.

established commercial check clones (G3, G48, D121 and Udai) could be compared against over all growth characteristics. Same way clones developed by WIMCO Ltd., U.P. Forest Department were found far behind in performance rank in comparison with above eleven listed clones. Udai did not register its entry in selection criteria but it was found among 12 closely followed clones (runner up) and these are UD-1009, UD-1003, UD-55, 63-N, S7C8, S7C1, 110702, Udai, 22/86, S7C15, PD-1 and L-200.

Khurana *et al.* (1992) reported that old clones namely D121, G3 and 3201 performed better in outer Shiwalik of Himachal Pradesh. However, it differs with our finding which seems to be the result of genetic make up of clones, climatic and edaphic condition of study site.

Sidhu (1996) reported the genetic evaluation on comparative performance of clones in the nursery for three year at Punjab Agriculture University, Ludhiana. Year to year performance of same clones varied in the same sides. Diameter and height were found non-significant among the clone in 1988 where as significant differences were observed in 1989 and 1990 for the same characteristics. In another nursery study carried out during 1990-92, it was reported that the clone 113324 emerged out best clones for all the three consecutive years (Sidhu, 1994). Palmberg (1977) found out highly significant differences for height growth and resistance among 32 clones of *P. deltoides* in Australia. Sharma *et al.* (1991) from FRI, Dehra Dun reported that clone D66 and S7C8 performed significantly better in nursery trial but these clones did not come up in ranking of Ist group of clones of the present study.

Singh and Negi (1996) conducted a nursery trial on Poplar clones in Himachal Pradesh and found that clones 110702, S7C1 and ST-72 were proved to be the best suited in lower hills of Himachal Pradesh. On the basis of field trial in Tarai region clones S7C4, S7C8, S7C15 and S7 C20 were found equally good to the clones G3 and G48 (Chandra and Joshi, 1994). Four clones of these two trial namely 110702, S7C1, S7C8 and S7C15 were also found promising clones of second line in our study.

Rao *et al.* (1993) conducted clonal trial in semi-arid region and they are of opinion to screen wide range of clones available from southern USA provenances. Wide range of clonal trial of Poplar will not only earmark suitable clone for different agro-climatic regions but it will also widen the genetic base of Poplar plantation (Singh and Beniwal, 1989; Chaturvedi and Rawat, 1994; Singh, 1999). Cao and Conner (1999) conducted an experiment in China for the selections of flood tolerant clones of *P. deltoides*. The findings reveal that seven clones were found suitable for 42 days flooding conditions. Same way Zheng *et al.*

(1991) have investigated drought resistance of Poplar clones and selected several clones of *P. deltoides* for planting in comparatively dry areas.

Positive and highly significant correlation between height and collar diameter growth showed that the clones with superior height also obtained corresponding diameter (Table 4). Randell and Cooper (1973) and Khurana *et al.* (1992) also reported high correlation between plant height and collar diameter growth. Therefore, both can be substantially improved simultaneously.

Poplar is one of the most befitting tree cash crops for agro-forestry models in India which necessitates to undertake nursery and field trails on Poplar so as to select suitable clones for large scale plantation in changing land use pattern of Eastern Uttar Pradesh. The findings of the present trial was aimed at assessing the differences in the performance between different genotypes in a given environment of the nursery and their further relative performance in the field.

Conclusion

G3, G48, S7C15 and D121 cover 90% Poplar plantations in the country. Based on growth performance, it is safely summarized that new clones of *Populus deltoides* had shown better performance which is exceedingly well in comparison to old clones. It further encourages to develop more new clones from introduction of germplasm from wider areas of Southern and Eastern USA and control breeding among selected land races (proven clones) of distant origins. Such attempt will serve two purposes i.e. widening of the genetic base of Poplar cultivation and bringing more areas under its cultivation due to better adaptability.

Undoubtedly, it is a bit early to jump upon for recommending any clone at this stage and at the same time large number of genotypes (clones) may not be feasible for field trial owing to the limited resources in hand. Therefore, nursery screening provides good indications for undertaking further field testing judiciously. However, it is well known that nursery performance of D121 is always better but it did not sustain its rank in field trial. With view to a ascertain juvenile mature correlation of promising clones, the field trials have already been initiated in these areas though multi-locational field testing under All India Coordinated Research Project on Poplar Improvement (FREEP-World Bank).

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SUMMARY

75 different clones of Populus deltoides were screened in nursery stage under Eastern Indo-Gangetic conditions for recommending suitable clones for large-scale plantation in different Agro-forestry systems. Four commercial clones namely G3, G48, D121 and Udai were treated as check and these were compared with the rest of the clones. Eleven best clones (D121, D124,

82-26-5, 34-N, 40-N, 25-N, UD-36, UD-5502, 90-12, UD-6502 and UD-4707) are earmarked on the basis of independent culling methods of selection. Another set of 12 clones were closely followed to the first set of 11 best clones are also graded as potential clones. The field trials of promising clones have already been undertaken for selecting the site matched clones for commercial culture of Poplar in Eastern parts of Uttar Pradesh.

पूर्वी उत्तर प्रदेश में पोपलर (*पा॰ डेल्टायडिस*) के कृन्तकों का मूल्यांकन – I रोपणी में परीक्षण

जी॰एस॰ रावत, एन॰बी॰ सिंह, आर॰के॰ गुप्त, के॰ सिंह व एस॰डी॰ शर्मा

सारांश

विभिन्न कृषि – वानिकी प्रणालियों में बड़े परिमाण पर रोपवन लगाने के लिए उपयुक्त रहने वाले कृन्तकों की सिफारिश करने के लिए पूर्वी सिन्धु गांगेय दशाओं में रोपणी स्तर पर *पापुलस डेल्टायडिस* के 75 विभिन्न कृन्तक परीक्षित किए गए । चार व्यापारिक कृन्तकों अर्थात् जी3, जी48, डी121 और उदय को नियामक माना गया तथा उनसे बाकी कृन्तकों की तुलना की गई । चुनाव करने की स्वतन्त्र चयन विधियों के आधार पर 11 सर्वोत्तम कृन्तक (डी121, डी24, 82 – 26 – 5, 34 – एन, 40 – एन, 25 – एन, यूडी – 36, यूडी – 5502, पीडी – 1, 90 – 12, यूडी – 6502 और यूडी – 4707) निश्चित किए गए । 11 कृन्तकों का एक अन्य कुलक जो सर्वोत्तम माने गए 11 कृन्तकों के कुलक से उनके बिल्कुल पीछे – पीछे लगता हुआ है, संभावनापूर्ण कृन्तक श्रेणी में रखा गया है । उत्तर प्रदेश के पूर्वी भागों में पोपलर के व्यापारिक संवर्धन के लिए स्थलोपयुक्त कृन्तकों का चुनाव करने के लिए उत्साहप्रद रहे कृन्तकों के क्षेत्रपरीक्षण पहले ही आरम्भ कराए जा चुके हैं ।

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