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SEED RECOVERY, SEED PRODUCTION, SEED PREDICTION AND VARIABILITY STUDIES IN CHILLI

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ABSTRACT

Seed recovery/fruit (SR) and several other related characters were investigated in 73 different genotypes of chilli. Each character exhibited wide variability. SR differed from cultivar to cultivar. Genotypes namely V.Kolar local, Habbegudi local and Anekal local gave high SR and they were recommended as donor parents for breeding cultivars with increased SR. They registered SR from 54.1% to 76.8%. SR showed positive correlation with seed weight/fruit, number of seeds/fruit, number of fruits/plant, fruit yield/plant, root dry weight/plant and stem diameter and negative correlation with fruit length, fruit size, fruit length:fruit diameter ratio, pericarp weight, pedicel weight and ascorbic acid content and these results provided an efficient tool for selection purposes. The characters seed weight/plant, pericarp weight, number of fruits/plant, pedicel weight and root dry weight/plant explained the variation in SR to an extent of 96.34% indicating accurate prediction of SR in the cultivars could be possible.

KEY WORDS : Chilli, genotype, seed recovery, variation, correlation, regression

Chilli (*Capsicum annuum* L.) is an important crop nutritionally and economically. The use of chilli in diet in India is increasing and it is grown in 0.759 m ha for local consumption and export with an average fruit yield (dry) of 0.802 t/ha and this poor yield was due to non-availability of quality seeds. To meet the farmer's demands of about 759,000 kg of seeds, production of genuine variety becomes an economically viable proposition. Again quality of seed production in a cultivar depends upon the seed recovery (SR) from the dry fruit weight. Fruit seed weight is not only important in determining dry fruit yield but also important to meet the seed requiremeents of farmers with lesser cost. It is therefore necessary to develop cultivars possessing high SR percentage or SR. Much of the variation in seed weight/fruit and consequently in SR results due to geneic differences. Information on nature and magnitude of variability in SR and its related traits among the germplasm is useful for breeding varieties for high SR. Further SR is a quantitative character influenced by several factors which are measured simultaneously and hence correlation studies will provide useful information for isoloation of the desired traits of the germplasm. There is very little work reported on SR in chilli. Production and prediction of seed are becoming important items of work of the scientists as seed plays the key role in crop production. Seed production and prediction could be estimated by undertaking regression analysis. The present study was therefore undertaken to study the variability among the SR and other related characters, to evaluate and isolate the genotypes giving high SR and to study the factors that would lead to increased seed production/fruit and seed prediction.

MATERIALS AND METHODS

The experiment was conducted in randomised complete block design with 73 genotypes of chilli and three replications at the Indian Institute of Horticultural Research, Bangalore. Rows were spaced 45 cm apart and plants within rows at 30 cm distance. Each plot consisted of a row of 3.60 m length. Measurements were recorded from five randomly selected plants from each plot including stem diameter (measured at the base of the stem at the soil surface with a caliper), plant height (from soil surface to apical bud), plant spread, number of primary and secondary branches/plant. Fifty fruits were selected at random during first picking from each plot and replication and the measurements on fruit length (FL) (cm), (the distance from pedicel attachment to its apex), fruit diameter (FD) (cm) (measured at its maximum width) and pedicle length (PL) (cm) (the distance between the points of attachment to the stem and to the fruit) were recorded using vernier calipers.

The fruits were dried well and weighed in grams. The pericarp, seed and the pedicel weights were recorded seprately. The average values were

analysed by analysis of variance technique. The number of seeds/fruit and the number of fruits/plant were counted and recorded. One thousand seed weight was determined from randomly selected seeds from each plot. Fruit size *viz.*, FL x FD and fruit ratio (FL/FD) were calculated for each fruit and average values were used for analyses. Root dry weight/plant and root volume/plant were also recorded for each plant. Dry fruit yield/plot and the quality traits namely ascorbic acid content, capsanthin content and capsaicin content were also determined. The SR was calculatted as SR = dry weight of the seed in the fruit / dry weight of the fruit and also expressed in percentage from the 50 fruit data for each genotype and replication. The average values were analysed by ANOVA and genotypes evaluated. Correlation between SR and each of the characters was worked out. Dependency of SR with one or more independent characters was tested by regression analysis and prediction equations fitted to predict SR. Correlation, simple and multiple regression analysis were carried out. In each case, the R^2 values were determined to know the amount of variability caused by the independent character or characters in the dependent vairable, SR.

RESULTS AND DISCUSSION

Data on name of genotype, entry number, dry fruit weight and its components are shown in Table 1 and variability in Table 2.

Variability

It was observed (Table 2) that all the characters studied showed wide variation. Maximum range of variation was observed for capsaicin content (CV 57.6%) followed by fruit shape (CV 51.6%), pedicel weight (CV 47.7%), number of fruits/plant (CV 44.9%) and fruit length (CV 35.5%). The CV for fruit seed weight and pericarp weight were 34.6 per cent and 37.5 per cent respectively.

Dry fruit weight

The maximum dry fruit weight (1.4808 g) was recorded in entry 88 (JCA-154) and minimum (0.3840 g) in entry 7 (Santaka). A similar range of variability was reported by Sarma and Roy (1995). ANOVA exhibited significant differences among the genotypes including the presence of wide genetic variability among the genotypes.

Seed recovery

Seed weight/fruit is an important component in the determination of dry fruit weight, SR and fruit yield/plant and Sahoo *et al.*,(1990) reported that it was a genetic factor. SR differed significantly among the genotypes. Based on least significant difference (P=0.05), the genotypes were classified into six groups A,B,C,D,E and F with one entry 46 with 76.8% SR in group, A, 5 entries (47,85,52,37 and 53) recorded SR from 65.1% to 54.1% in group B, 24 recorded SR from 53.3% to 42.6% in group C, 36 recorded SR from 42.2% to 31.8% in group D, 6 recorded SR from 30.8% to 24.9% in group E and one entry 19 recorded SR the lowest (18.6%) in group F. The ratios dry weight:pericarp weight and dry fruit weight: pedicel weight also exhibited significant differences. The recovery of pericarp weight/fruit ranged from 20.5% (entry 46) to 60.3% (entry 26). The higher SR in the genotypes indicated the lesser pericarp and pedicel recoveries due to the negative relationships.

Correlation analysis

SR was positively associated with fruit seed weight/fruit (r=0.6018), number of seeds/fruit (r=0.5542), number of fruits/plant (r=0.4178), fruit yield/plant (r=0.3015), root dry weight/plant (r=0.2917) and stem diameter (r=0.2354) indicating that selection based on greater values of these characters could result in cultivars having increased SR. SR showed negative correlation with fruit size (r=-0.5377), fruit length r=-0.5345, fruit pericarp weight (r=-0.5301), fruit shape (r=-0.3957), fruit pedicel weight (r=-0.3615) and ascorbic acid content (r=-0.2735). The above coefficients were significant at P = 0.01. As the fruit length, pericarp weight, pedicel weight and fruit size goes on increasing, the seed weight in the fruit becomes decreased due to the distribution of food materials to the fruit parts other than seed thus causing lesser seed weight.

Setiamihardja and Knavel (1990) reported that the ratios FL:FD and pedicel lenngth (PL): pedicel diameter (PD) are controlled by the same gene system and hence selection based on lesser FL:FD as well as PL:PD would lead to increased SR. The

Table 1. Details on names of genotypes, dry fruit weight and recovery of seed, pericarp and pedicel weights from dry fruit in different genotypes of chilli

Name of genotype	Dry fruit wt (g)	Recover from dry fruit					
		Seed wt. in		Pericarp wt.in		Pedicel wt.in	
		(g)	(%)	(g)	(%)	(g)	(%)
Pinocchio pepper	0.4722	0.1748	37.0	0.1900	40.2	0.1074	22.8
IHR-45	0.4330	0.2222	51.3	0.1800	41.6	0.0308	7.1
IHR-268	0.7638	0.2634	34.4	0.4560	59.7	0.0444	5.8
Mulato Rogue	0.7802	0.3292	42.2	0.3700	47.4	0.0810	10.4
Ducale	1.2166	0.3870	31.8	0.6940	57.0	0.1356	11.2
Santaka	0.3840	0.1494	38.9	0.1880	49.0	0.0466	12.1
Salem local	0.5082	0.2266	44.6	0.2440	48.0	0.0376	7.4
Anal	0.7902	0.2888	36.6	0.4556	57.7	0.0454	5.7
Arun	1.0164	0.1886	18.6	0.7740	76.2	0.0538	5.2
Arun local	0.8850	0.3566	40.3	0.4720	53.3	0.0564	6.4
Attapadi	0.8828	0.3404	38.6	0.4800	54.4	0.0624	7.0
IHR-263	0.9108	0.3084	33.9	0.3460	38.0	0.2564	28.1
IHR-264	0.6816	0.3070	45.0	0.2900	42.6	0.0846	12.6
IHR-265	0.5180	0.1474	28.5	0.2740	52.9	0.0966	18.6
IHR-266	0.5702	0.1964	34.4	0.3440	60.3	0.0298	5.3
IHR-268	0.4918	0.0236	48.0	0.2060	41.9	0.0498	10.1
IHR-270	0.8942	0.2948	33.0	0.5320	59.5	0.0674	7.5
IHR-271	0.9986	0.3596	36.0	0.5360	53.7	0.1030	10.3
Assam local	0.5508	0.2300	41.8	0.2600	47.2	0.0608	11.0
Meerut local	0.6784	0.2770	40.8	0.3440	50.7	0.0574	8.5
Hebbagudi loc	0.4118	0.2232	54.2	0.1620	39.3	0.0266	6.5
Shankeshwar	0.7078	0.2354	33.3	0.4040	57.1	0.0684	9.6
Bayadagi	0.7142	0.2008	24.9	0.4600	64.4	0.0766	10.7
IHR-302	0.7452	0.2008	27.0	0.4640	52.3	0.0804	10.7
Examba	0.7306	0.3238	44.3	0.3380	46.3	0.0688	9.4
DH-7-6-5	0.6242	0.2062	33.0	0.3480	55.8	0.0700	11.3
DH-7-6-6	0.4898	0.1728	35.3	0.2660	54.3	0.0510	10.4
DH-7-6-12	0.5318	0.1880	35.4	0.2940	55.3	0.0498	9.3
Ronyal llocal	0.7760	0.4138	53.3	0.3600	46.4	0.0022	0.3
Ronyal	0.8882	0.4228	47.6	0.3920	44.1	0.0734	8.3
Kortical loc	0.5818	0.2076	35.7	0.3040	52.3	0.0702	12.0
Kortical	0.7756	0.3964	51.1	0.2960	38.2	0.0832	10.7
Gowribidnur B.	0.7396	0.2786	37.7	0.4000	54.1	0.0610	8.2
Gowribidnur 1.	0.9086	0.6980	76.8	0.1860	20.5	0.0246	2.7
Byadgeri 1.	0.8168	0.5316	65.1	0.2440	29.9	0.0412	5.0
Sardhana 1-3	0.8582	0.4534	52.8	0.3340	38.9	0.0708	8.3
Sardhana 1-4	0.4462	0.1670	37.4	0.2300	51.6	0.0492	11.0
Gowribidnur	0.8600	0.3580	41.6	0.4600	53.5	0.0420	4.9
Red Local(B)	0.8402	0.4086	48.6	0.3760	44.8	0.0556	6.6
V.Kolar red	0.6238	0.3422	54.9	0.2360	37.8	0.0456	7.3
Anekal local	0.4962	0.2686	54.1	0.1840	37.1	0.0436	8.8
Belgaum local	0.6724	0.2070	30.1	0.3740	55.6	0.0914	13.6
Musalwadi	0.7924	0.3446	43.5	0.3900	49.2	0.0578	7.3
Devdurg local	0.9664	0.4754	49.2	0.4120	42.6	0.0790	8.2
Vijayawada 1.	0.8144	0.3468	42.6	0.4060	49.9	0.0616	7.5
Raichur chili	0.7870	0.3274	41.6	0.4040	51.3	0.0556	7.1
Bellari khaddi	0.7004	0.2240	32.0	0.4020	57.4	0.0744	10.6
Kurnool chilli	0.6158	0.2734	44.4	0.2920	47.4	0.0504	8.2
Dabigai chilli	0.5966	0.3148	52.8	0.2280	38.2	0.0538	9.0
JCA-232	1.2536	0.4626	36.9	0.6940	55.4	0.0970	7.7
JCA-20	1.1656	0.4538	38.9	0.6100	52.3	0.1018	8.8
Charlapally	0.8512	0.4190	49.2	0.3780	44.4	0.0542	6.4
Guntur chilli	0.8002	0.4036	50.4	0.3440	43.0	0.0526	6.6
Guntur chilli	1.2400	0.5894	47.5	0.5629	45.3	0.0086	7.2

Table 1. (Contd.)

Name of genotype	Dry fruit wt (g)	Recover from dry fruit					
		Seed wt. in		Pericarp wt.in		Pedicel wt.in	
		(g)	(%)	(g)	(%)	(g)	(%)
Varanasi loc.	0.4838	0.2084	43.1	0.2360	48.8	0.0394	8.1
4217 France	1.1548	0.3354	29.0	0.7380	63.9	0.0814	7.1
Vardhana	0.8450	0.3170	37.5	0.4420	52.3	0.0860	10.2
Kashmir local	0.7928	0.4196	52.9	0.2960	37.3	0.0722	9.8
HR-525	0.9562	0.3780	39.5	0.4960	51.9	0.0822	8.6
HR-529	0.7702	0.4056	52.7	0.3260	42.3	0.0386	5.0
HR-531	0.8576	0.3615	42.1	0.3960	46.3	0.1002	11.7
Kalyanpur red	0.8386	0.2804	33.4	0.4820	57.5	0.0762	9.1
Kalyanpur ch.	0.6004	0.1990	33.2	0.3520	58.6	0.0494	8.2
Kalyanpur	0.6284	0.2536	40.4	0.3180	50.6	0.0568	9.0
KA 31B	1.1134	0.4150	37.3	0.6100	54.8	0.0884	7.9
[illegible]	0.6682	0.2790	41.8	0.3180	47.6	0.0712	10.6
[illegible]5	0.7974	0.3896	50.8	0.3160	41.2	0.0618	8.0
[illegible]2	0.8146	0.3840	47.1	0.3680	45.2	0.0626	7.7
[illegible]nt -C1	0.5576	0.3116	55.9	0.2040	36.6	0.0420	7.5
[illegible]A 960	0.7682	0.3344	41.9	0.3880	38.6	0.0758	9.5
[illegible]O 1	0.8040	0.3490	43.4	0.3860	48.0	0.0790	8.6
KA-154	1.4808	0.5844	39.5	0.7800	52.7	0.1164	7.8
Pusa Jwala	0.6772	0.2012	29.7	0.4300	63.5	0.0460	6.8
Mean	0.7652	0.3179	41.8	0.3802	49.2	0.0671	9.0
SEm	0.0252	0.0129	..	0.0164	..	0.0037	..
Maximum	1.4808	0.6980	76.8	0.7800	76.2	0.2564	28.1
Minimum	0.3840	0.1886	18.6	0.1860	20.5	0.0022	0.3
CV(%)	28.1	34.6		37.6		47.7	
LSD (P=0.05)	0.2642	0.1082	11.03	0.1303		0.0228	

positive association of root dry weight/plant with SR emphasized the importance of well developed root system while breeding cultivars for enhanced SR. Seed weight/fruit and fruit yield/plant was positively correlated and hence seed weight/fruit was an important compoent not only to increase SR but also fruit yield. It was worth to note that the ascorbic acid content was negatively correlated with SR and hence one has to consider this relationship while breeding for increasing the SR.

Regression analysis

Regression analysis showed that SR was affected by fruit seed weight, number of seeds/fruit, fruit size, FL, fruit and pericarp weight to a greater extent than other characters. To achieve higher SR, one has to select the genotypes having lesser fruit length, fruit diameter, pericarp and pedicel weights. The other characters namely plant height, plant spread, number of primary and secondary branches/plant, PL, FD, capsanthin and capsaicin contents of the fruit failed to show any influence on SR showing thereby their lesser importance in increasing SR.

Multivariate analysis of variance is required to obtain a more complete analysis of the traits that are important in determining genotypic differences in SR. The simple linear correlation and regression data showed that there was scope for improving the accuracy of predictions of SR as the explained variation in SR was only 36 per cent. In multiple regression analysis only the traits which showed significant correlation were considered. Multiple regression coefficients of two or more combinations of variables indicated that in each combination the relative contribution were highly significant. The combination of variables *viz.*, seed weight/fruit, fruit pericarp weight, fruit pedicel weight and root dry weight/plant were superior to others and their contribution was 96.3 per cent. The relative contribution of different combinations namely i) seed weight/fruit and fruit size, ii) seed weight/fruit, fruit length and fruit pericarp weight and iii) seed weight/fruit, fruit pericarp weight and number of fruits/plant were 71.66 per cent, 93.66 per cent and 95.11 per cent respectively. The results with the variables namely ascorbic acid content, stem diameter, fruit weight/plant, FL:FD

Table 2. Variability parameters for some of the characters relating to the recovery of seed studies in chilli genotypes

Character	Mean	SE	Maximum	Minimum	Range	CV(%)
No.of seeds/fruit	64.8	2.49	132.5	31.5	101.0	32.8
Fruit length (FL) (cm)	8.19	0.34	14.73	1.39	13.40	35.5
Fruit diameter (FD) (cm)	1.22	0.033	2.43	0.65	1.78	23.0
Fruit size (FL x FD)	9.74	0.391	16.74	1.89	14.85	34.3
No.of fruits/plant	46.10	2.43	126.3	8.7	117.60	44.9
Fruit shape (FL:FD)	7.24	0.433	20.37	1.0	19.37	51.0
Dry fruit yield per plant (g)	26.69	1.12	48.0	11.3	36.7	34.5
Root dry wt/plant (g)	39.08	0.89	53.67	0.9	52.77	19.6
Stem diameter (cm)	1.27	0.02	1.68	0.71	0.97	15.9
Plant spread (cm)	52.09	1.09	68.9	17.5	51.4	17.8
Plant height (cm)	58.39	1.35	82.5	24.9	57.6	19.9
Number of secondary branches/plant	13.61	0.51	43.4	5.1	38.3	32.2
Number of primary branches/plant	5.34	0.12	7.8	2.7	5.1	18.8
Root vol./plant (cc)	10.07	0.39	25.7	4.5	21.2	30.8
1000 seed wt. (g)	4.92	0.1005	7.68	3.44	4.24	17.4
Pedicel length (cm)	2.95	0.0550	4.35	1.69	2.66	16.0
Ascorbic acid content (mg/100g)	130.16	3.76	192.1	58.7	133.4	24.7
Capsanthin content(%)	0.245	0.0065	0.407	0.126	0.281	22.7
Capsaicin content(%)	0.689	0.0465	1.810	0.055	1.755	57.6
Fruit dry weight (g)	0.765	0.025	1.481	0.384	1.097	28.1

ratio and number of seeds/fruit showed less improvement in their relative contribution than others in the variability of SR.

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APPLICATION OF REMOTE SENSING TO STUDY THE ENVIRONMENT AND ECOSYSTEM. A CASE STUDY FOR SECONDARY ANALYSIS OF VEGETATION

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ABSTRACT

Four types of vegetation *viz*., moist sal forest, moist mixed forest, dry mixed forest and seral vegetation were identified at the Kanha National Park using remote sensing data products *viz*., satellite imageries (Landsat -TM-FCC 1:50,000 scale) and aerial photographs (B/W Panchromatic 1:10,000 scale). Secondary analysis of the vegetation interms of index of similarity has revealed that there was highest similarity between *Terminalia tomentosa* and moist mixed forest as *T. tomentosa* was the most abundant and dominant tree species in moist mixed forest. Also there were more similarity between Sal (*Shorea robusta*) and *T. tomentosa* forests. *S. robusta* forest was the most dominant among all the vegetation in the study area. The dry mixed and moist mixed forests were having greater diversity, indicating the richness of the tree species, compared to sal forest and seral vegetation.

KEY WORDS : Remote sensing, aerial photographs, satellite imageries, environment, ecosystem, vegetation analysis