The Andhra Agric. J 60(3): 568-573, 2013

Effect of Various Population Schemes on Mean, Variance, and Coefficient of Variation of Yield and Yield Attributes in Sunflower (*Helianthus Annus* L.)

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ABSTRACT

The present investigation was carried out at Regional Agricultural Research Station, Nandyal, Andhra Pradesh to study the effectiveness of various population improvement schemes in improving yield and yield attributes. The Morden open pollinated population was chosen for imposing population schemes like mass selection, half sib, full sib selection and selfed progeny selection schemes.The base population allotted for various selection schemes revealed that the attributes plant height, head diameter, 100-seed weight, oil per cent, oil yield and seed yield / plant exhibited wider variability in the form of mean, range, variance and coefficient of variation.Increase in head diameter, oil per cent and seed yield / plant were found in MS_2 *kharif* and *rabi* seasons over that of MS_0 population. Whereas in BS_2 population, in different seasons, the mean values of all the yield attributes were lower than BS_0 and BS_1 populations except 100-seed weight and oil percent in summer season.The HS_2 and FS_2 population showed increased mean values in oil yield and seed yield/plant over the base population. However, HS_2 population further showed an improvement in the mean values in the attributes like head diameter, 100-seed weight and oil percent. However, in S_2 bulk population, oil yield and seed yield / plant were mostly affected characters when compared to S_0 and S_1 populations.The variance and co-efficient of variation were reduced as the generations advanced in all the populations of mass selection, bulk sib selection, half sib, full sib selection and selfed progeny selection schemes.

Key words : Coefficient, Sunflower, Yield.

Sunflower (Helianthus annus L.) cultivation in India started in 1969 with the introduction of four Russian and a Canadian variety i.e. VNIIMK 8931 (EC-68413), Peredovic (EC-68414), Amavirskii 3497 (EC-68415), Armaverts (EC-69874) and Sunrise respectively. Subsequently, one early maturing germplasm line EC-101495 (Cerniaka-66) was identified during screening and evaluation of germplasm collection at Bangalore. This line on its introduction from USSR into Canada was called by name Morden. Later this was released as Morden variety in Karnataka in the year 1979.

The Morden variety was released in 1979 in Karnataka and even today this variety is widely grown in the country. The most prominent methods enumerated by Virupakshappa, 1994 were 1) Mass selection 2) Pustovit method 3) half Sib family 4) full sib family 5) Selfed progeny evaluation. All these methods have been imposed individually on the base material and improvements were studied. However, the studies on relative efficiency of all these methods on a single base material are meager and needs to be thoroughly investigated to launch a massive programme for improvement of open pollinated varieties in Sunflower for seed and oil yield.

The present investigations, Morden variety was chosen for imposing various population improvement selection schemes as this variety is the most stable, early, short stature and dependable variety grown with varying managerial skills and input capacities of the farmers in different environments.

Thus the present investigation aimed at in open pollinated Morden Variety with the following objective.

To compare the efficiency of mass selection (MS), Bulk Sib (BS), half sib (HS), Full Sib (FS) and selfed progeny (S) Selection Schemes in improving yield and yield attributes.

MATERIAL AND METHODS

The present investigation was carried out from *kharif* 1997 to *rabi* 1999 at the Regional Agricultural Research Station, Nandyal, Andhra Pradesh.

Field Plot Technique during *Kharif*, 1997:

During *Kharif* 1997, the open pollinated base population of Morden was sown in isolation at Regional Agricultural Research Station, Nandyal, Andhra Pradesh in an area of 1800 square meters. Nearly 10,000 plants were raised by adopting a spacing of 60 cm between rows and 30 cm between plants with in a row.

Before flowering the experimental plot was divided into 20 grids of equal size (abut$\pm$ 500 plants in a grid). Four grids were randomly allotted to each of the five selection methods.

The Population of MS_2, BS_2, HS_2, FS_2, S_2 bulk and open pollinated variety morden as check were raised during 1998 – 99 summer, 1999 kharif and 1999 rabi in a randomized block design with four replications with a spacing of 60 cm between rows and 30 cm plant to plant within a row. Each population in a replication was sown in ten rows each with a 3 meters row length. The data recorded on individual plants was used to work out mean, range, variance and co-efficient of variation in all seasons.

Field Plot Technique during Rabi 1997:

The selected bulks of mass and bulk sib selections made during kharif 1997 were advanced to raise as MS_1 and BS_1 populations during rabi 1997. Recommended cultural practices were followed to maintain good plant stand and healthy crop. Similar procedure as described in the previous season followed to maintain good plant stand and healthy crop. The procedure as described in the previous season was followed in mass and bulk sib material in MS_1 and BS_1 generation. The seed of these generations harvested separately and designated as MS_2 and BS_2 for sowing in the next season.

Sixty six S_1 progenies were grown in a randomized block design with two replications. Recommended cultural practices were followed to maintain good stand and healthy crop. Prior to flowering, five plants in each progeny lines were bagged to enforce selfing and remaining plants in each progeny line were left for recording date. At maturity the data was recorded on each of the left over plants in each of the progeny line. Based on yield data, Superior progenies were identified and seeds of corresponding selfed plants were bulked to raise it as S_2 bulk progeny in the next season.

After retaining 50 percent of the seed as remnant, selected 115 HS_1 and 123 FS_1 progenies were planted in separate trials in randomized block design with two replications. Each progeny was represented by a row of 15 plants. Recommended cultural practices were followed. In these two experiments, in each of progeny line, observations were recorded on five randomly selected plants. Based on seed yield and oil yield, top five percent of progeny lines were identified. Based on this data, the corresponding remnant seeds of the lines were taken and mixed to raise as HS_1 and FS_1 generations.

Field Plot Technique during Rabi 1998:

The Hs_1 generation was raised in isolation duly followed by recommended cultural practices to maintain good plant stand and healthy crop. The entire population was left for random pollination and at maturity the entire population was harvested in bulk and preserved to raise it as HS_2 in the next season.

Similarly FS_1 were raised in isolation and plants were bagged and crossed interse. At maturity equal quantity of seed from each cross was taken and mixed to raise as FS_2 in the next season.

Statistical Analysis:

The data obtained from MS_0, BS_0, HS_0, FS_0, S_0, MS_1, BS_1, HS_1, FS_1, S_1 and MS_2, BS_2, FS_2, and S_2 in different seasons were used to estimate range, mean, variance and co-efficient of variation.

RESULTS AND DISCUSSION

The most commonly applied intrapopulation improvement methods in sunflower breeding are mass selection, pustovoit method of seed reserves, S_1 selection, half sib and full sib progeny selection and recurrent selection methods.

In the present investigation, the most popular methods viz., mass selection, bulk sib selection, half sib and full sib selection and selfed progeny selection with slight modifications were employed to assess the relative efficiency of these approaches in improving yield and yield attributes in the open pollinated sunflower variety Morden.

Mass selection

In the MS_1 generation, mass selection has not shown any effect in influencing the mean values of all the characters studied over the base population in the positive direction. However, in the MS_2 generation, there was an improvement in the head diameter, oil per cent, oil yield / plant and seed yield / plant during *kharif* and *rabi* seasons over base population and MS_1 generation population. Whereas increased stem thickness was found in MS_2 rabi population than the base and MS_1 generation (Table 1).

Table 1. Effect of Mass selection, Bulk Selection on mean, variance and coefficient of variation of yield and yield attributes to different generations of sunflower

S.No	Characters		Generations									
			MS_0	MS_1	MS_2(S)	MS_2(K)	MS_2(R)	BS_0	BS_1	BS_2(S)	BS_2(K)	BS_2(R)
1.	Plant height (cm)	m	93.50	82.50	58.60	79.60	74.00	90.20	83.00	65.70	80.60	81.30
		v	36.00	112.36	40.96	5.76	3.61	136.99	114.49	108.16	43.56	4.00
		cv	6.42	12.84	7.90	3.10	2.40	12.90	12.90	15.90	7.50	2.50
2.	Head diameter (cm)	m	13.32	12.18	7.65	17.09	17.62	17.78	13.00	8.46	15.60	16.78
		v	9.79	4.88	1.56	0.58	1.16	7.89	10.11	1.02	0.31	0.30
		cv	23.49	18.44	16.39	4.45	6.17	15.80	24.46	11.99	3.61	3.33
3.	Stem thickness (cm)	m	2.66	2.40	0.76	1.81	3.48	3.54	2.67	0.83	1.79	2.60
		v	0.34	0.16	158.26	0.05	0.02	0.30	0.05	0.01	0.15	0.02
		cv	21.80	16.67	16.56	12.38	3.97	15.53	8.23	11.90	21.89	5.95
4.	Days to maturity	m	87.52	86.41	81.23	81.41	81.20	85.91	87.41	81.51	81.20	80.91
		v	0.50	0.82	0.41	1.17	0.41	2.28	2.22	0.92	0.83	0.50
		cv	0.81	1.05	0.89	1.32	0.70	1.71	1.61	1.12	1.06	0.91
5.	100 Seed weight (g)	m	6.11	6.07	5.23	3.92	3.41	5.04	5.21	5.80	3.72	3.13
		v	0.46	0.39	0.22	0.03	0.05	1.53	14.97	0.27	0.21	0.03
		cv	11.13	10.38	9.09	4.82	6.57	24.60	74.35	9.12	12.36	5.19
6.	Oil percent	m	32.85	28.31	27.41	39.70	33.68	31.28	35.02	36.71	33.44	31.00
		v	7.45	16.97	171.40	4.16	2.62	16.89	52.27	16.97	0.21	111.94
		cv	8.31	14.55	15.13	5.14	4.82	13.13	20.66	11.23	3.88	1.84
7.	Oil yield / plant (g)	m	6.06	4.21	1.69	7.70	7.07	6.93	3.83	3.97	5.06	5.48
		v	1.06	1.51	0.10	0.26	0.14	1.96	1.53	0.17	1.66	0.04
		cv	16.90	29.22	19.08	6.67	5.27	27.41	32.52	10.72	6.67	3.91
8.	Seed yield / plant (g)	m	18.49	15.14	6.23	20.06	22.64	22.38	11.98	10.89	16.31	18.20
		v	8.91	13.98	0.30	0.35	0.05	39.94	92.16	0.44	0.09	0.45
		cv	15.68	24.70	8.85	6.67	6.57	28.23	80.09	6.13	1.91	3.70

m= mean v = variance cv = coefficient of variation

S = Summer, 1998-99 K = Kharif, 1999 R = Rabi, 1999

Table 2: Effect of half sib, full sib selection on mean, variance and coefficient of variation of yield and yield attributes in different generations of sunflower

S.No	Characters		Generations									
			HS_0	HS_1	$HS_2(S)$	$HS_2(K)$	$HS_2(R)$	FS_0	FS_1	$FS_2(S)$	$FS_2(K)$	$FS_2(R)$
1.	Plant height (cm)	m	95.20	85.30	60.30	88.70	86.00	84.10	87.50	66.40	95.80	92.80
		v	219.04	96.04	75.69	21.16	19.36	174.24	81.00	193.21	30.25	3.24
		cv	15.50	11.49	14.5	5.20	2.50	15.70	10.28	20.90	5.70	2.10
2.	Head diameter (cm)	m	17.72	11.36	8.93	19.03	20.66	17.43	9.87	8.90	22.03	21.60
		v	8.58	1.29	1.32	0.25	0.33	2.66	1.44	3.72	1.37	0.18
		cv	16.47	10.04	12.89	2.65	3.33	9.35	12.17	21.71	5.33	4.27
3.	Stem thickness (cm)	m	3.55	2.97	0.93	2.99	4.36	3.24	2.00	0.86	4.39	4.64
		v	0.32	0.36	1.10	0.18	0.17	0.20	0.07	0.05	0.08	0.02
		cv	16.06	20.20	34.19	14.66	5.95	13.86	13.26	26.96	6.70	14.24
4.	Days to maturity	m	85.81	80.97	83.04	81.43	81.44	85.20	81.45	84.00	81.34	80.93
		v	1.27	6.45	3.09	0.55	1.08	47.74	3.47	2.66	0.55	1.54
		cv	1.32	3.14	1.75	0.91	0.99	8.10	2.25	1.94	0.91	1.11
5.	100 Seed weight (g)	m	3.55	4.40	5.40	5.13	4.53	5.11	3.49	6.40	6.57	6.89
		v	0.36	2.07	0.15	0.03	0.08	0.81	2.92	1.32	0.32	0.06
		cv	16.90	35.77	7.39	3.50	5.19	17.61	49.00	18.06	8.71	5.58
6.	Oil percent	m	32.46	30.11	34.43	42.76	41.08	32.87	31.01	33.80	47.66	48.36
		v	11.16	7.78	9.36	0.96	115.56	5.71	6.25	7.95	0.92	0.53
		cv	10.28	9.29	8.91	2.31	0.58	7.27	8.06	8.35	2.03	1.81
7.	Oil yield / plant (g)	m	7.82	3.84	4.53	12.79	13.10	6.24	3.11	2.84	18.96	18.62
		v	3.96	0.41	0.56	0.13	0.16	1.93	2.78	0.14	0.29	0.56
		cv	25.44	19.86	16.69	2.93	3.10	22.27	53.37	1.35	2.86	4.05
8.	Seed yield / plant (g)	m	24.08	10.81	13.16	30.57	32.44	19.08	5.26	8.47	39.85	41.98
		v	27.56	3.53	3.53	0.26	0.34	16.16	7.89	0.59	0.30	0.01
		cv	21.80	17.41	14.34	1.67	0.67	21.06	23.42	9.19	1.39	2.13

m= mean v = variance cv = coefficient of variation

S = Summer, 1998-99 K = Kharif, 1999 R = Rabi, 1999

Table 3. Effect of selfed progeny on mean, variance and coefficient of variation of yield and yield attributes in different generations of sunflower.

S.No	Characters		Generations				
			S_0	S_1	S_2(S)	S_2(K)	S_2(R)
1.	Plant height (cm)	m	80.10	84.50	64.20	68.10	71.30
		v	193.21	0.49	94.09	15.84	3.24
		cv	17.40	0.82	15.10	5.60	2.10
2.	Head diameter (cm)	m	14.26	9.76	8.04	10.50	10.98
		v	10.82	0.92	2.46	0.16	0.18
		cv	23.07	9.88	19.52	3.88	4.27
3.	Stem thickness (cm)	m	1.96	1.89	0.77	1.40	1.60
		v	0.28	0.06	0.02	0.80	0.02
		cv	27.06	12.72	20.53	20.91	14.24
4.	Days to maturity	m	82.69	81.42	84.32	79.92	80.84
		v	4.04	3.42	0.64	2.19	1.54
		cv	2.47	2.25	0.92	1.72	1.11
5.	100 Seed weight (g)	m	6.17	5.23	4.58	2.48	3.30
		v	1.28	2.10	0.72	0.13	0.06
		cv	18.37	27.80	0.92	14.66	5.58
6.	Oil percent	m	33.40	28.52	32.77	40.12	40.72
		v	6.10	23.72	5.57	0.69	0.03
		cv	7.39	17.09	7.21	2.07	1.81
7.	Oil yield / plant (g)	m	6.10	3.89	2.47	2.90	2.79
		v	1.61	2.13	0.07	0.03	0.03
		cv	20.81	77.24	11.68	5.54	6.28
8.	Seed yield / plant (g)	m	18.41	6.01	7.55	7.49	6.76
		v	13.39	7.56	0.21	0.11	0.25
		cv	19.88	45.70	6.02	4.41	2.13

m= mean v = variance cv = coefficient of variation

S = *Summer*, 1998-99 K = *Kharif*, 1999 R= *Rabi*, 1999

The variance and coefficient of variation values were maximum in MS_1 generation population over the base population in the characters viz., plant height, oil per cent, oil yield and seed yield / plant. Whereas head diameter, stem thickness and days to maturity, in general, showed low variance and coefficient of variation compared to that of the base population. The variance and coefficient of variation in MS_2 generation for almost all the characters were lower than that of MS_1 and also base population except for oil per cent (Table 1).

Whereas Shivakumar (1995) reported phenotypic co-efficient of variability was not reduced in MS_2 when compared to MS_1 population. He also reported the *per se* mean for seed yield, oil content and oil yield were lower in MS_2 than MS_1 and this might be due to seasonal differences in which these two generations were raised. In the present study also seasonal effects were observed, where in, the *summer* season mean, variance and coefficient of variation in MS_2 were lower than that of MS_1 generation for almost all yield and yield attributes.

Bulk sib selection

The variance and coefficient of variation were higher in BS_1 population over BS_0 population for attributes like head diameter, 100 seed weight, oil per cent oil yield and seed yield / plant. However, the same trend was not maintained between BS_2 and BS_1 populations. In BS_2 population, the variance and coefficient of variation were low when compared to BS_0 and BS_1 populations (Table 1).

Half sib selection

The variance and co-efficient of variation for plant height, head diameter, oil per cent, oil yield / plant and seed yield / plant were low in all the seasons of HS_2 when compared to HS_0 and HS_1 populations. Whereas HS_2 populations in *summer* for stem thickness and oil per cent in *rabi* showed higher coefficient of variation than HS_0 and HS_1 populations (Table 2).

Low variance and coefficient of variation in the HS_2 populations for many attributes is expected as selection was exercised for superior progeny lines in HS_1 generation and thus resulted in narrowing down of genotypic differences. The *kharif* and *rabi* seasons were found to be more favourable for expression of head diameter, 100 seed weight, oil per cent, oil yield and seed yield / plant.

Full sib selection

Low mean values were recorded for all the attributes studied in FS_1 population than FS_0 population except plant height. FS_2 populations in *kharif* and *rabi* showed higher mean values for all the attributes than FS_0 and FS_1 populations except days to maturity (Table 2).

The *kharif* and *rabi* seasons were found to be more favourable for full sib selection also. Similar type of observations was made by Shivakumar (1995).

Selfed progeny selection

S_1 progeny population showed lower mean values for all the attributes studied than the S0 base population. Similarly, S_2 bulk population in different seasons also showed further reduction in yield and yield attributes over the S_0 and S_1 populations except oil per cent. The variance and coefficient of variation in S_2 population were lower than the S_0 base population for all the attributes. (Table 3)

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(Received on 03.02.2012 and revised on 16.06.2012)