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EFFECTS OF BIPARENTAL MATING IN FORAGE OATS

D. PANT, S. N. MISHRA* AND J. S. VERMA

Department of Plant Breeding, G. B. Pant University of Agriculture and Technology Pantnagar, Nainital 263145

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ABSTRACT

Effects of biparental matings (BIP) were studied in two oat (*Avena sativa* L.) crosses alongwith their parents. The mean values of BIPs were better than the mean values of parents (selfed) for all the charactrs studied in both the crosses. In general, the lower limit of range shortened and the upper limit increased in desired direction. The analysis of variance of biparental progenies indicated significant variation among BIPs (for both the crosses) for all the characters studied except leaf width and leaf:stem ratio in the cross, UPO 210 x UPO 136. A comparison of genotypic and phenotypic correlations among the characters between the biparental progenies and selfs indicated several new correlations in the BIPs as compared to the selfs in both the crosses suggesting breakage of the linkages.

Key words: Biparental mating, oats.

Oat is predominantly a self pollinated crop and thus its populations are characterized by homozygous balance. For the development of new oat (*Avena sativa* L.) cultivars the segregating progenies are usually handled by the pedigree method. Such a conventional procedure, though significant and productive in its own right, imposes restrictions on the chances of recombination because of larger linkage blocks. Biparental mating design has been advocated by Hanson [1] for breaking larger linkage blocks in self-pollinated crops in the initial 4–5 generations of intermating and thereby releasing more variability along with improving the performance of progenies produced after intermating selected F_2 individuals in pairs. The present investigation was therefore, initiated to study the effects of biparental and selfed progenies, obtained from the two oat crosses, on mean performance, release of additional genetic variability and shifts in correlation coefficients.

MATERIALS AND METHODS

Biparental progenies were developed in F_2 generation of two crosses viz, UPO 210 x

*Addressee for correspondence.

UPO 136 and UPO 212 x UPO 136, during Rabi, 1988-89. Nine BIPs were developed by paired crossing of F_2 plants in each of the two crosses and the selected plants (males and females) were also selfed. The ABIPs (augmented BIPs) consisting of BIPs and the selfs (9 BIPs and 18 selfs of males and females in each cross) were evaluated in the randomized complete block design with two replications during Rabi 1989-90. Each treatment was planted in 3 m long rows spaced 45 cm apart. Seed to seed distance was kept at 9 cm. Twenty randomly selected plants from each treatment were taken for observation on days to 50% heading, tillers per plant, plant height, leaf length, leaf width, leaf:stem ratio and green forage yield. Data were analysed as per procedure given by Kearsey [2].

RESULTS AND DISCUSSION

The comparison of mean values of different characters (Table 1) between BIPs and parents (selfed) indicated that, in general, the mean values of BIPs were better than the mean values of parents (selfed) for all the characters studied in both the crosses. The mean values were higher in the case of biparental progenies for number of tillers per plant, plant height, leaf length, leaf width, leaf:stem ratio, and green forage yield. However, it was lower for days to 50% heading in both the crosses indicating possibility of getting early genotypes. In general the lower limits of the range were shortened for almost all the characters in the BIPs indicating a trend of reduction of undesirable genotypes. The upper limit of the range was, however, increased in desired direction for leaf width in both the crosses and for number

Table 1. Mean and range (in parentheses) for different characters of BIPs and corresponding parents (selfed) in crosses UPO 210 x UPO 136 and UPO 212 x UPO 136

Character	UPO 210 x UPO 136		UPO 212 x UPO 136	
	parents (selfed)	BIPs	parents (selfed)	BIPs
Days to 50% heading	115.2 (108–124)	111.3 (98–119)	116.9 (110–124)	114.7 (103–121)
Tillers per plant	6.7 (3.7–9.4)	7.2 (5.9–8.5)	6.7 (5.1–8.6)	7.2 (5.4–9.3)
Plant height (cm)	163.8 (138–184)	168.3 (153–178)	163.1 (149–173)	168.0 (157–180)
Leaf length (cm)	49.0 (43–55)	51.5 (47–54)	49.5 (46–54)	51.9 (49–56)
Leaf width (cm)	3.2 (3.1–3.4)	3.3 (3.2–3.5)	3.3 (3.2–3.4)	3.4 (3.3–3.5)
Leaf : stem ratio	0.30 (0.24–0.38)	0.32 (0.25–0.38)	0.33 (0.24–0.42)	0.31 (0.27–0.43)
Forage yield (g/plant)	210.9 (141–320)	306.8 (178–438)	232.0 (155–392)	291.6 (210–387)

of tillers per plant, plant height, leaf length and leaf:stem ratio in the cross, UPO 212 x UPO 136. In the cross, UPO 210 x UPO 136 the upper limit increased for forage yield. The upper limit of the range was reduced for days to 50 per cent heading in both the crosses.

The superior means and generally wider ranges in the BIPs may be primarily due to generation of more genetic variability than in F_3. Mishra et al. [3] and Prasad [4] also observed an increase in the mean performance of biparental progenies over selfed progenies (F_3).

The analysis of variance of augmented BIPs (Table 2) indicated significant differences between BIPs for all the characters in both the crosses except plant height and leaf length in the cross, UPO 210 x UPO 136. The variance of BIP means were higher for days to 50 per cent heading, leaf length and forage yield in the cross UPO 210 x UPO 136 while it was higher for tillers per plant, leaf width and leaf:stem ratio in the cross UPO 212 x UPO 136. Mean variance of the BIPs indicated higher estimates for days to 50% heading, plant height and leaf length in the cross UPO 210 x UPO 136 and for tillers per plant, leaf width and forage yield in the cross UPO 212 x UPO 136. The parents vs BIPs component indicated presence of significant dominance component for all the seven characters in both the crosses. Predominance of additive and dominance component have also been reported by Solanki et al. [5] and Manga and Sidhu [6] for such traits in oats.

Table 2. ANOVA and variance components ($V_{\overline{BIP}}$ and $\overline{V}_{BIP}$) for seven traits in two oat crosses

Source	d.f.	Days to 50% heading	Tillers per plant	Plant height	Leaf length	Leaf width	Leaf:stem ratio	Forage yield
Treatments	26	45.9** (28.7)**	2.8** (1.7)**	102.8 (90.3)**	8.4 (8.2)**	0.007** (0.01)**	0.002** (0.002)**	9729.1** (7720.1)**
Parents (selfed)	17	33.0** (22.1)**	3.5** (1.4)**	104.3 (81.6)**	4.4 (5.7)**	0.006** (0.005)**	0.001** (0.001)**	3134.71 (6207.0)**
BIPs	8	57.0** (38.7)**	1.3* (2.4)**	81.1 (91.0)**	9.1 (5.3)**	0.01** (0.01)**	0.002** (0.004)**	11158.7** (6568.7)**
Parents vs BIPs	1	176.3** (60.8)**	2.5** (2.4)**	250.6** (285.2)**	70.3** (75.1)**	0.02** (0.08)**	0.006** (0.009)**	110395.4** (42669.9)**
Error	26	4.7 (3.4)	0.5 (0.3)	57.6 (15.8)	5.6 (1.6)	0.002 (0.001)	0.0007 (0.0005)	1049.9 (636.9)
$V_{\overline{BIP}}$		25.3 (17.3)	0.6 (1.0)	30.6 (40.0)	4.2 (2.4)	0.004 (0.005)	0.0007 (0.002)	5421.4 (3022.8)
$\overline{V}_{BIP}$		6.5 (4.1)	0.1 (0.3)	19.9 (10.0)	0.7 (0.5)	0.003 (0.004)	0.0007 (0.0003)	315.2 (523.2)

*, **Significant at 5 and 1% probability levels, respectively.

Note: Figures outside parentheses for cross UPO 210 x UPO 136 and those in parentheses for cross UPO 212 x UPO 136.

A comparison of genotypic correlations among the characters between the BIPs and parents (selfed) (Table 3) indicated several new correlations in terms of magnitude and direction in both the crosses. For example, in the cross, UPO 210 x UPO 136, forage yield had very low correlation with tillers per plant (0.01) and leaf:stem ratio (0.04) in the selfs (F_3) but it increased substantially in the BIPs (0.95 and 0.60, respectively). Similarly the directions of association of forage yield with days to 50% heading (0.08 in self to –0.55 in BIP) and leaf width (–0.30 in self to 0.73 in BIP) changed. In the cross UPO 212 x UPO 136 the correlation of tillers per plant with leaf:stem ratio changed from 0.19 in the self to 0.62 in the BIPs. Similarly in the case of leaf:stem ratio with forage yield, it changed from 0.40 to 0.94. Change from negative to positive correlation was observed between plant height and leaf width (–0.10 in self to 0.77 in BIPs) and between leaf length and leaf width (–0.16 in self to 0.84 in BIPs). Such changes in magnitude and direction may occur due to gene reshuffling and breakage of linkages due to biparental matings in the segregating populations. The study thus indicated that intermating in early generations (F_2 or F_3) coupled with selection would not only effectively accumulate the favourable genes but also maintains variability for the selection to be effective.

Table 3. Some important genotypic correlations (rg) in BIP and selfs in two oat crosses

Correlation	Changes in direction and magnitude of r_g			
	UPO 210 x UPO 136		UPO 212 x UPO 136	
	self	BIP	self	BIP
Days to 50% heading with:				
leaf length	0.18	–0.51	–0.41	–0.91
leaf width	0.13	–0.83	–0.45	–0.98
leaf : stem ratio	0.05	0.95	–0.35	–0.94
forage yield	0.08	–0.55		
Tillers per plant with:				
leaf width	–0.37	0.93		
leaf:stem ratio	0.26	0.84	0.19	0.62
forage yield	0.01	0.95		
Plant height with:				
leaf length	–0.52	0.63		
leaf width	–0.67	1.02	–0.10	0.77
Leaf length with:				
leaf width			–0.16	0.84
Leaf width with:				
leaf:stem ratio	0.06	0.75		
forage yield	–0.30	0.73		
Leaf:stem ratio with:				
forage yield	0.04	0.60	0.40	0.94

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