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Identification of promising single cross hybrids in maize (*Zea mays* L.)

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Abstract
Forty five single cross hybrids made involving 10 inbreds of maize in a half diallel fashion excluding reciprocals were tested for their performance at Agricultural Research Station, Perumallapalle, Andhra Pradesh from 2016-17 to 2017 adopting randomised block design with three replications for three seasons *viz*., *rabi*, 2016-17, *summer*, 2017 and *kharif*, 2017 seasons. Data were recorded for 15 characters *viz*., days to 50% tasseling, days to 50% silking, anthesis-silking interval, days to maturity, plant height, SPAD chlorophyll meter readings (SCMR), specific leaf area, specific leaf weight, ear length, ear girth, number of kernel rows ear^{-1}, number of kernels row^{-1}, 100 seed weight, harvest index and grain yield plant^{-1}. Pooled analysis over seasons for hybrids revealed the significant differences among hybrids, seasons and hybrids × seasons for all the characters suggesting the existence of variability among hybrids, seasons and differential response of hybrids to seasons due to genotype × seasons interaction for the characters studied. Out of 45 hybrids, the hybrids *viz*., Heypool × PDM 1474 followed by BML 7 × DFTY, DFTY × Heypool, BML 15 × PDM 1474 and BML 6 × PDM 1474 recorded the highest *per se* performance in the descending order for grain yield plant^{-1}. Hence, these hybrids could be exploited for commercial cultivation directly after ascertaining their performance under MLT's and on-farm trials over locations/years or could be well utilized in population improvement programme or in heterosis breeding so as to bring improvement in grain yield and yield related characters as these hybrids not only showed superior performance for grain yield but also for the most important yield attributes such as ear length, ear girth, number of kernel rows ear^{-1}, number of kernels row^{-1}, 100 seed weight and harvest index.

Keywords: Maize, hybrids, yield and yield components, over seasons

Introduction
Maize is an important cereal crop worldwide and is ranked third after wheat and rice for its nutritional quality and uses (Ali *et al*. 2014) [1] and it is termed as "Queen of Cereals". It is mostly used as food, feed, forage, green fuel (ethanol), vegetable oil and starch. It is also backbone of the poultry industry. The significant increase in maize production in India was due to commercial cultivation of highly productive single cross hybrids. Genotype × environment interaction complicates the identification of stable/consistently performing hybrids over seasons/locations (Comstock and Moll, 1963; Kang and Gorman, 1989 and Kang and Gauch, 1996) [7, 12, 13]. Therefore, newly developed hybrids should be tested in multiple environments to determine their performance and adaptability before recommending for commercial cultivation as G×E interaction may cause inconsistencies in genotype ranking across environments and selection of suitable maize hybrids. The present investigation was carried out to identify superior hybrids for enhancing productivity of maize under commercial cultivation.

Material and Methods
The present investigation was carried out in maize involving 45 hybrids derived from ten inbreds *viz*., BML 2, BML 6, BML 7, BML 15, DFTY, Heypool, PDM 1416, PDM 1428, PDM 1452 and PDM 1474 made in a half diallel fashion at Agricultural research Station, Perumallapalli, Chittoor District, A.P from 2016-17 t0 20127 in three seasons *viz*., *Rabi*, 2016-17, *Summer*, 2017 and *Kharif*, 2017 seasons. The soils are sandy to sandy loam in texture. All the recommended package of practices *viz*., irrigation, weeding and plant protection measures for maize in southern zone were followed in raising a healthy and successful crop. Farm yard manure was applied at the rate of 25 t ha^{-1}. Nitrogen was applied in four splits *viz*., at sowing, knee high stage (30-35 days), at flag leaf emergence (50-55 days) and at tasseling and silking

stage (60-65 days) as per the recommendations of Southern Zone, Andhra Pradesh. A fertilizer dose of 120:80:60 kg ha^{-1} of nitrogen, phosphorous and potassium during *rabi*, 2016-17 and *summer*, 2017 and 100:80:60 kg ha^{-1} nitrogen, phosporous and potassium during *kharif*, 2017 was applied.
The observations on 15 characters *viz*., days to 50% tasseling, days to 50% silking, anthesis-silking interval, days to maturity, plant height (cm), SPAD chlorophyll meter reading (SCMR), specific leaf area (cm^2 g^{-1}), specific leaf weight (mg cm^{-2}), ear length (cm), ear girth (cm), number of kernel rows ear^{-1}, number of kernels row^{-1}, 100 seed weight (g), harvest index (%) and grain yield $plant^{-1}$ (g) were recorded during crop growth period and at harvest. Pooled analyses of data overall the three seasons was also carried out after testing for the homogeneity of error variances by using Bartlett's test of homogeneity (Bartlett, 1937) [3] as quoted by Panse and Sukhatme (1985) [12]. The seasons were considered as random, while F_1 hybrids were assumed as fixed.

Results and Discussion

Pooled mean data analysis for 45 hybrids indicated existence of significant differences among hybrids, seasons and hybrids × seasons for all the characters studied over seasons. Existence of sufficient variability among hybrids for all the characters studied indicates that desirable improvement can be brought through selection. Mean performance of hybrids over three seasons for all 15 characters studied were presented on character wise in Table 1.

Days to 50% tasseling

Among hybrids, BML 15 × PDM 1452 (59.56) took least number of days, whereas BML 15 × PDM 1428 (65.44) took the maximum number of days to tasseling with a general mean of 62.36 days. Among the 45 hybrids 21 recorded less number of days for days to 50% tasseling over hybrid mean. The hybrid BML 15 × PDM 1452 followed by Heypool × PDM 1474, DFTY × PDM 1452, BML 7 × DFTY, BML 15 × PDM 1474 and DFTY × Heypool exhibited earliness in flowering (Table 1). Overall, hybrids took less number of days for days to 50% tasseling compared to inbreds in individual seasons and in pooled over seasons. This showed that hybrids were relatively early in tasseling than inbreds.

Days to 50% silking

This character varied from 62.67 (BML 15 × PDM 1452) to 69.44 (BML 15 × PDM 1428) among hybrids with a mean value of 65.59 days. The top five hybrids *viz*., BML 15 × PDM 1452, Heypool × PDM 1474, DFTY × Heypool, BML 7 × DFTY and DFTY × PDM 1452 have recorded less number of days for days to 50% silking (Table 1). Days measured to 50% silking along with other maturity characters are commonly used by plant breeder as a basis for determining maturity of maize. Low mean performance is an indicative of earliness. In the present investigation BML 15 × PDM 1452, Heypool × PDM 1474, DFTY × Heypool, BML 7 × DFTY and DFTY × PDM 1452 and among hybrids registered low mean values for silking and thus are considered to be best hybrids for earliness. Hence, these hybrids could be used for development of earliness in the hybridization programme.

Anthesis-Silking Interval

Anthesis-silking interval among hybrids varied from 2.41 (Heypool × PDM 1416) to 4.15 days (BML 15 × PDM 1428) in pooled over seasons. The hybrid mean recorded in pooled over seasons was 3.25. Among 45 hybrids, hybrid Heypool × PDM 1416 in pooled over seasons recorded minimum number of days for anthesis-silking interval. Anthesis-silking interval reveals the time span between anthesis to pollination. It is a character used mainly in screening genotypes for tolerant to stress especially drought resistant. It is highly correlated with seed setting *per cent* in a reciprocal way. Lesser the gap between tasseling to silking in a cross, greater will be grain yield. The hybrid Heypool × PDM 1416 registered low anthesis-silking interval in three seasons and pooled over seasons and could be used in development of high yielding hybrid programme.

Days to maturity

In pooled over seasons days to maturity varied among hybrids from 99.33 (BML 7 × DFTY) to 105.67 (BML 15 × PDM 1428) with a mean of 101.88 days. Among the 45 hybrids 20 hybrids surpassed by respective hybrid mean values in desired direction. Thus, these hybrids were relatively early in maturity than the in breads. Among the 20 hybrids, the top five hybrids include BML 7 × DFTY, DFTY × PDM 1474, DFTY × Heypool, DFTY × PDM 1452 and PDM 1452 × PDM 1474 for early maturity in pooled over seasons (Table 1). Days to 50% tasseling, days to 50% silking and days to maturity indicates earliness of a genotype in maize. Earliness is a desirable character as it is useful in multiple cropping and increases water and land use efficiency.

Plant height (cm)

Plant height among hybrids varied from 166.59 (BML 7 × DFTY) to 203.13 cm (BML 6 × PDM 1428) in pooled over seasons. A hybrid mean of 187.08 cm was recorded for this character in pooled over seasons. Twenty four hybrids in pooled over seasons exceeded the respective hybrid mean value. The top five hybrids *viz*., BML 6 × PDM 1428, BML 6 × PDM 1452, DFTY × PDM 1428, PDM 1416 × PDM 1428 and BML 6 × PDM 1474 in pooled over seasons registered maximum plant height (Table 1). Plant height is strongly associated with the flowering dates, both morphologically and ontogenetically, because internodes formation stops at floral initiation, which means that earlier flowering is usually shorter in maize (Troyer and Larkins, 1985) [17]. In the present investigation also hybrids which were much early in flowering recorded low plant height compared to hybrids which recorded higher plant height and late in flowering.

SPAD chlorophyll meter readings (SCMR)

Significant differences were observed among the hybrids in pooled over seasons for SPAD meter readings. Chlorophyll is a vital pigment for absorbing, transferring and transforming in photosynthesis (Yao *et al*., 2007) [19]. Leaf greenness is an important plant biophysical parameter that determines plant physiological status and relates to photosynthetic capacity of plants and consistently improves yield. Among hybrids, SCMR varied from 48.86 (BML 7 × PDM 1428) to 53.70 (DFTY × Heypool) with a general mean value of 51.36 in pooled over seasons. Among the hybrids, 21 in pooled over seasons recorded higher SCMR over the respective general mean of hybrids. The top five hybrids which recorded higher SCMR include DFTY × Heypool, BML 6 × PDM 1474, BML 7 × DFTY, BML 15 × PDM 1452 and BML 15 × PDM 1474 in pooled over seasons. In the present study most of the high yielding hybrids recorded higher SCMR (Table 1). Higher SPAD chlorophyll meter readings in high yielding genotypes were also reported by Ghimire and Timsina (2015) [9] and Rigon and Rigon (2014) [16] in maize. A change in the SPAD based chlorophyll meter readings due to environmental factors and crop leaf characteristics as recorded in the present study were also noted by Amanullah *et al*. (2007) [2] and Xiong *et al*. (2015) [18] in maize.

Specific leaf area (cm^2 g^{-1})

This character ranged among hybrids from 80.38 (PDM 1428 × PDM 1452) to 90.70 cm^2 g^{-1} (BML 15 × PDM 1474) in pooled over seasons. Low SLA is desirable in maize for getting higher yield. Among the 45 hybrids studied, 23 in pooled over seasons registered significantly lower SLA values compared to the hybrid mean of 85.03 cm^2 g^{-1} (Table 1). Top five hybrids *viz*., PDM 1428 × PDM 1452, BML 7 × PDM 1416, BML 6 × BML 7, BML 2 × PDM 1428 and BML 6 × PDM 1416 in pooled over seasons recorded significantly low SLA values (desired direction). Specific leaf area is a measure of leaf thickness and photosynthate production/translocation balance (Chatterton *et al*. 1972) [6]. In the present study higher SLA was recorded in *rabi* followed by *kharif* and was low in *summer*. Danalatos *et al*. (1994) [8] reported in maize that thickness of leaves increases under high light intensities and photosynthetic rates. The results of the present study are in tune with the findings of Blackman *et al*. (1955) [4], Gmeling Meyling (1973) [10] and Brower *et al*. (1973) [5] who have reported that SLA is affected by temperature and leaves become thicker at lower temperature.

Specific leaf weight (mg cm^{-2})

Among hybrids, the character varied from 1.11 (BML 15 × PDM 1452) to 1.27 mg cm^{-2} (PDM 1428 × PDM 1452) in pooled over seasons. The general mean value recorded in hybrids for SLW was 1.18 mg cm^{-2} in pooled over season. (Table 1). Higher SLW values are desirable to record higher yields in maize. Among the hybrids, PDM 1428 × PDM 1452 pooled over seasons recorded significantly higher SLW values compared to the respective general mean for this character (Table 1). Higher SLW is desirable for higher yields in maize.

Ear length (cm)

Among hybrids ear length varied from 16.68 (Heypool × PDM 1416) to 19.19 cm (DFTY × Heypool) in pooled over seasons. The hybrid mean value recorded for this character was 17.71 cm. Among 45 hybrids, 18 hybrids in pooled over seasons recorded superior ear length over mean of hybrids. The top five hybrids which recorded higher ear length include DFTY × Heypool, BML 6 × PDM 1474, BML 15 × PDM 1474, BML 7 × DFTY and DFTY × PDM 1452 in pooled over seasons. (Table 1). All these hybrids also recorded higher grain yield. Similar results were also recorded by Ghimire and Timsina (2015) [9] and Rigon and Rigon (2014) [16].

Ear girth (cm)

Ear girth among hybrids varied from 13.50 (PDM 1416 × PDM 1428) to 15.45 (BML 15 × PDM 1474) with a mean of 14.38 cm in pooled over seasons. Among 45 hybrids, 20 hybrids in pooled over seasons recorded higher ear girth compared to respective general hybrids mean (Table 1). The highest ear girth was recorded in the hybrids *viz*., BML 15 × PDM 1474, DFTY × PDM 1452, PDM 1452 × PDM 1474, BML 7 × DFTY and BML 15 × PDM 1452 in pooled over seasons. In the present study high yielding hybrids recorded higher ear girth. These results are in tune with the findings of Ghimire and Timsina (2015) [9] and Rigon and Rigon (2014) [16] in maize,

Number of kernel rows ear^{-1}

Number of kernel rows ear^{-1} ranged from13.45 (PDM 1416 × PDM 1452) to 15.58 (BML 15 × PDM 1474) among hybrids with a hybrid mean value of 14.34 in pooled over seasons. Seventeen hybrids in pooled over seasons showed higher mean performance for kernel rows ear^{-1} compared to the respective hybrids mean. The top performing hybrids for number of kernel rows ear^{-1} include BML 15 × PDM 1474, PDM 1452 × PDM 1474, BML 2 × PDM 1474, BML 6 × PDM 1474 and Heypool × PDM 1474 in pooled over seasons (Table 1). A positive association of number kernel rows ear^{-1} with grain yield as observe in the present study were also reported by Ghimire and Timsina (2015) [9] and Rigon and Rigon (2014) [16] in maize.

Number of kernels row^{-1}

Number of kernels row^{-1} among hybrids varied from 33.89 (PDM 1416 × PDM 1428) to 41.31 (BML 7 × DFTY) with a mean value of 37.63. Among 45 hybrids, BML 7 × DFTY, BML 15 × PDM 1474, Heypool × PDM 1474, DFTY × Heypool, BML 6 × PDM 1474, BML 15 × PDM 1452 and DFTY × PDM 1452 registered more number of kernels row^{-1} compared to hybrids mean. Twenty three out of 45 hybrids surpassed the general mean of the hybrids (Table 1). All the hybrids which recorded more number of kernels per row also recorded higher grain yield. These results are also in agreement with the findings of Ghimire and Timsina (2015) [9] and Rigon and Rigon (2014) [16] in maize.

Hundred seed weight (g)

Hundred seed weight ranged among hybrids ranged from 29.29 (PDM 1416 × PDM 1452) to 35.26 (BML 15 × PDM 1452) with a mean of 33.13 g in pooled over seasons. Twenty hybrids over seasons recorded significantly higher 100 seed weight compared to the respective general mean of hybrids. The top five superior hybrids which registered higher 100 seed weight include BML 15 × PDM 1452, BML 7 × DFTY, PDM 1452 × PDM 1474, BML 15 × PDM 1474 and BML 6 × PDM 1474 in pooled over seasons (Table 1). In the present study the hybrids which recorded higher 100 seed weight have also recorded higher grain yield. Ghimire and Timsina (2015) [9] and Rigon and Rigon (2014) [16] have also observed similar results in maize.

Harvest index (%)

In pooled over seasons, this character varied among hybrids from 36.49 (BML 2 × BML 15) to 38.51 (BML 15 × PDM 1452) with mean of 37.64%. Among the hybrids *viz*., BML 15 × PDM 1452, BML 7 × DFTY, BML 15 × PDM 1474, Heypool × PDM 1474 and DFTY × PDM 1452 recorded highest harvest index when compared to hybrids mean (Table 1). Harvest index varied among hybrids pooled over seasons indicating the existence of differences among hybrids and seasons. Climate and soil conditions are the two most important factors affecting harvest index. Higher harvest index was recorded in *rabi* compared to *summer* which could be due to more favourable conditions during *rabi* season. Seasonal variation for harvest index in maize was also recorded by Ion *et al*. (2015)

Grain yield plant^{-1} (g)

This character varied from 98.77 (BML 15 × PDM 1428) to 139.19 (Heypool × PDM 1474) plant^{-1} among hybrids with a general mean of 120.56 g which was exceeded by 24 hybrids. The five top performing hybrids for grain yield plant^{-1} across the three seasons were Heypool × PDM 1474 (139.19 g), BML 7 × DFTY (137.19 g), DFTY × Heypool (137.06 g), BML 15 × PDM 1474 (137.01 g) and BML 6 × PDM 1474 (133.63 g) (Table 1). *Per se* performance of 45 hybrids studied over three seasons indicated that as many as 21 hybrids have recorded significantly higher grain yield when compared to the released public hybrid DHM 117. Out of these, Heypool × PDM 1474, BML 7 × DFTY, DFTY × Heypool, BML 15 × PDM 1474 and BML 6 × PDM 1474 were found early in tasseling and silking at least two or three days than DHM 117 indicating the possibility for the isolation of hybrids with high yield potential and earliness.

It is evident from the results of the present investigation that out of 45 hybrids, the hybrids *viz*., Heypool × PDM 1474, BML 7 × DFTY, DFTY × Heypool, BML 15 × PDM 1474 and BML 6 × PDM 1474 recorded the highest *per se* performance in the descending order for grain yield over three seasons. These hybrids could be exploited for commercial cultivation directly after ascertaining their performance under on-farm trials in different locations and environments or could be well utilized in population improvement programme in maize so as to bring improvement in grain yield and yield related characters as these hybrids not only showed superior performance for grain yield but also for most important yield attributes such as ear length, ear girth, number of kernels row ear^{-1}, number of kernels row^{-1}, 100 seed weight and harvest index and involved either one or two inbred possessing good combining ability effects for most of the yield contributing characters (Sabitha, 2021) [14].

Based on the *per se* performance for grain yield and yield components over three seasons, five single cross hybrids *viz*., Heypool × PDM 1474, BML 7 × DFTY, DFTY × Heypool, BML 15 × PDM 1474 and BML 6 × PDM 1474 were identified as top yielding single cross hybrids. All these superior single cross hybrids registered high mean performance and heterosis for most of the yield components and involved either one or two inbred possessing good combining ability effects for most of the yield contributing characters. Hence, these hybrids could be exploited for commercial cultivation directly after ascertaining their performance under MLT's and on-farm trials in different locations/years or could be well utilized in population improvement programme or in heterosis breeding so as to bring improvement in grain yield and yield related characters as these hybrids not only showed superior performance for grain yield but also for most important yield attributes such as ear length, ear girth, number of kernel rows ear^{-1}, number of kernels row^{-1}, 100 seed weight and harvest index.

Table 1: Mean performance of F_1 hybrids for grain yield and yield contributing characters pooled over three seasons in maize

S. No	Hybrid (s)	DT	DS	ASI	DM	PH	SCMR	SLA	SLW	EL	EG	NKRE	NKPR	KW	HI	GYP
1	BML 2 × BML 6	63.11	66.22	3.11	102.82	196.00	50.42	83.48	1.20	17.25	14.11	14.07	37.22	32.43	37.76	125.47
2	BML 2 × BML 7	63.11	66.44	3.37	102.92	187.29	51.46	83.96	1.19	17.52	15.08	14.26	38.67	34.07	36.76	127.52
3	BML 2 × BML 15	63.22	67.22	3.89	104.12	186.41	50.74	83.33	1.20	17.04	13.78	13.92	36.67	31.15	36.49	113.41
4	BML 2 × DFTY	61.11	63.89	2.74	102.64	183.67	52.87	85.10	1.18	17.92	14.71	14.56	38.56	34.64	37.78	123.24
5	BML 2 × Heypool	64.00	68.00	4.00	100.05	178.36	52.28	87.07	1.15	18.44	15.01	15.22	38.22	34.13	37.07	129.48
6	BML 2 × PDM 1416	61.89	65.33	3.41	101.57	193.73	50.06	81.56	1.23	17.56	14.34	14.19	36.89	32.43	37.57	120.37
7	BML 2 × PDM 1428	63.22	66.78	3.63	102.33	181.77	50.69	82.34	1.22	17.04	14.40	13.97	37.56	32.71	37.56	114.77
8	BML 2 × PDM 1452	63.00	66.67	3.63	102.33	187.76	49.34	83.64	1.17	17.16	13.89	13.79	36.44	32.40	37.23	119.14
9	BML 2 × PDM 1474	61.78	64.78	3.04	101.28	194.53	52.57	86.98	1.14	18.99	15.14	15.52	38.67	34.61	37.88	127.23
10	BML 6 × BML 7	64.00	67.22	3.19	103.00	192.40	50.23	81.99	1.22	17.17	13.83	13.80	36.33	31.53	37.06	111.25
11	BML 6 × BML 15	64.00	67.44	3.48	103.44	184.36	49.96	84.10	1.19	16.99	13.94	13.88	36.33	32.09	37.71	109.35
12	BML 6 × DFTY	61.11	64.33	3.19	102.00	180.00	52.08	86.42	1.16	18.02	14.27	14.31	38.33	33.62	37.66	125.37
13	BML 6 × Heypool	62.56	65.56	3.04	101.18	184.26	51.77	86.19	1.17	18.10	14.42	14.40	38.22	31.89	37.69	121.57
14	BML 6 × PDM 1416	62.89	66.11	3.26	103.38	189.33	51.20	82.89	1.21	17.80	14.82	14.51	37.67	34.09	37.68	124.51
15	BML 6 × PDM 1428	63.89	67.11	3.30	103.33	203.13	52.02	83.91	1.22	16.78	13.56	13.87	35.89	31.80	37.61	113.80
16	BML 6 × PDM 1452	61.56	64.00	2.44	100.33	201.31	49.52	84.40	1.19	17.01	13.95	13.89	36.56	31.80	37.34	122.63
17	BML 6 × PDM 1474	61.22	64.44	3.26	100.11	196.44	53.62	87.40	1.15	19.18	15.28	15.44	40.33	35.16	38.10	133.63
18	BML 7 × BML 15	63.00	66.33	3.37	102.11	192.73	50.33	83.51	1.20	17.00	13.96	14.03	36.33	32.30	37.28	107.50
19	BML 7 × DFTY	60.67	63.56	2.89	99.33	166.59	53.57	89.39	1.11	19.12	15.32	15.21	41.31	35.20	38.41	137.19
20	BML 7 × Heypool	63.22	66.33	3.22	102.00	175.16	51.80	85.90	1.17	17.99	14.26	14.26	38.33	32.89	37.60	120.15
21	BML 7 × PDM 1416	62.56	65.67	3.15	102.02	192.22	49.98	83.22	1.20	17.16	13.52	13.74	36.73	32.38	37.52	105.09
22	BML 7 × PDM 1428	63.00	66.33	3.30	102.56	189.12	48.86	83.11	1.21	16.96	13.82	13.66	35.22	32.44	37.25	115.72
23	BML 7 × PDM 1452	62.67	65.67	3.04	101.89	183.10	49.02	84.70	1.17	17.14	13.98	13.93	36.11	32.76	37.28	116.14
24	BML 7 × PDM 1474	62.67	66.11	3.44	102.89	178.58	50.84	85.59	1.17	17.71	13.98	14.18	38.00	32.63	37.61	122.36
25	BML 15 × DFTY	61.56	65.00	3.56	101.09	181.95	50.70	85.43	1.17	17.56	14.29	14.04	39.22	33.04	37.26	119.27
26	BML 15 × Heypool	62.89	66.33	3.56	101.78	189.78	51.16	85.57	1.17	17.50	14.51	14.61	38.00	33.33	37.73	125.17
27	BML 15 × PDM 1416	62.22	65.44	3.15	102.89	189.29	50.42	83.64	1.20	16.68	13.96	13.61	34.67	31.81	36.83	106.08
28	BML 15 × PDM 1428	65.44	69.44	4.15	105.67	181.39	50.38	84.56	1.18	16.86	13.81	13.47	34.33	30.50	37.38	98.77
29	BML 15 × PDM 1452	59.56	62.67	3.22	101.13	169.76	53.41	89.41	1.12	18.73	15.30	14.99	40.33	35.26	38.51	131.16
30	BML 15 × PDM 1474	60.89	64.11	3.30	100.22	166.73	53.41	90.70	1.11	19.13	15.45	15.58	40.89	35.17	38.39	137.01
31	DFTY × Heypool	60.89	63.56	2.63	99.89	179.67	53.70	86.76	1.17	19.19	15.28	15.23	40.44	35.00	37.99	137.06
32	DFTY × PDM 1416	62.89	66.44	3.52	102.44	192.81	51.84	86.36	1.16	17.67	14.55	14.49	36.78	32.98	38.07	114.59
33	DFTY × PDM 1428	62.89	66.22	3.37	102.22	197.11	51.96	84.81	1.18	17.61	14.01	14.53	37.67	33.98	37.72	126.54
34	DFTY × PDM 1452	60.44	63.67	3.15	99.94	185.58	52.69	85.91	1.17	19.06	15.43	15.24	40.33	34.74	38.23	133.01
35	DFTY × PDM 1474	62.33	65.44	3.15	99.77	182.78	52.93	87.93	1.14	18.25	14.22	14.26	39.67	32.67	38.14	125.14
36	Heypool × PDM 1416	61.89	64.33	2.41	102.44	192.00	51.21	85.87	1.17	17.58	14.47	14.01	38.00	33.99	38.15	114.79

37	Heypool × PDM 1428	61.89	64.67	2.81	101.33	189.97	52.79	85.27	1.18	18.48	14.75	14.09	36.89	33.83	37.93	117.79
38	Heypool × PDM 1452	61.44	64.56	3.15	101.78	192.93	52.27	85.75	1.17	18.15	14.61	14.49	38.11	34.47	37.84	127.47
39	Heypool × PDM 1474	60.00	63.11	3.07	100.13	182.42	52.46	85.94	1.17	18.17	15.24	15.29	40.78	35.04	38.30	139.19
40	PDM 1416 × PDM 1428	64.00	67.56	3.56	103.56	197.07	51.00	83.62	1.20	16.80	13.50	13.46	33.89	30.86	37.13	102.54
41	PDM 1416 × PDM 1452	61.44	64.89	3.41	101.56	192.56	50.34	84.33	1.19	16.90	13.66	13.45	34.89	29.29	37.73	107.20
42	PDM 1416 × PDM 1474	61.11	64.22	3.15	101.22	185.73	50.26	83.66	1.20	17.18	13.86	14.12	37.56	32.51	37.24	123.12
43	PDM 1428 × PDM 1452	63.00	66.33	3.41	102.67	191.84	49.59	80.38	1.27	17.09	13.50	13.69	34.22	32.47	37.94	102.29
44	PDM 1428 × PDM 1474	63.56	66.33	2.74	103.22	183.11	50.47	84.28	1.17	17.10	13.74	14.34	36.22	33.54	37.37	121.89
45	PDM 1452 × PDM 1474	62.22	65.56	3.30	100.00	195.96	52.80	85.88	1.17	18.40	15.39	15.54	39.89	35.20	38.14	128.28
	Mean	62.36	65.59	3.25	101.88	187.08	51.36	85.03	1.18	17.71	14.38	14.34	37.63	33.13	37.64	120.56
	SE(m)	0.41	0.50	0.35	0.51	4.23	0.64	1.44	0.018	0.43	0.19	0.31	0.97	0.50	0.25	4.13
	CD at 5%	1.96	1.42	0.95	1.43	11.88	1.79	4.05	0.054	1.22	0.53	0.87	2.74	1.41	0.70	11.49
	C.V. (%)	1.15	1.33	18.05	0.87	3.91	2.14	2.93	2.69	4.22	2.28	3.72	4.49	2.63	1.15	5.93
	Lowest	59.56	62.67	2.41	99.33	166.59	48.86	80.38	1.11	16.68	13.50	13.45	33.89	29.29	36.49	98.77
	Highest	65.44	69.44	4.15	105.67	203.13	53.70	90.70	1.27	19.19	15.45	15.58	41.31	35.26	38.51	139.19

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