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Morphological traits association with fodder and seed yield in *Vigna unguiculata* (L.)

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Abstract

In cowpea, dual purpose plant types are more preferable for cultivation. Therefore, exotic and indigenous cowpea germplasm lines were evaluated in augmented design to study estimates of the correlation coefficients and path analysis of morphological as well as fodder and grain yield attributes. The present study showed a high impact of direct effects of correlation (0.9714**) and suggested that going for plant types with higher biomass per plant (0.8856**), dry weight per plant (0.4598), stem girth (0.2336) number of secondary branches (0.2788), leaves per plant (0.3251), pods per plant (0.9059) and pod clusters per plant (0.7718) would be effective for improving both fodder and seed yield in cowpea.

Key words

Vigna unguiculata, Path coefficient, Fodder, Morphological traits

Introduction

Cowpea is a warm-season, annual, herbaceous legume and one of the most ancient crops known to man. It is now a broadly adapted crop with high variability, cultivated around the world primarily for seed, and secondarily as vegetables (for leafy greens, green pods, fresh shelled green peas, and shelled dried peas), a cover and fodder crop. It possesses wide intra species diversity for various traits (Annonymous, 2007). Generally, farmers prefer dual purpose plant types of cowpea for cultivation. The vining type is preferred for forage or cover crop use, while the bush type is better suited for inter-cropping. Kumar *et al.* (2001) evaluated genotypes of cowpea to estimate the correlations and path coefficients for morphological traits. Parmar *et al.* (2003) studied association analysis for grain yield and contributing characters in cowpea. Erkut and Cengiz (2004) compared some cowpea (*Vigna unguiculata* l. walp) genotypes from Turkey for seed yield and yield related characters, by determining correlation and path coefficients between them. Kumawat and Raje (2005) also studied association analysis in cowpea. Based on estimates of the phenotypic and genotypic correlation coefficients, it may be suggested to lay more emphasis on particular characters in selection programmes aiming to improve grain and fodder yields in cowpea. In the present study, both exotic and indigenous cowpea germplasm lines were evaluated in augmented design to study the estimates of the correlation coefficients, character correlation and path analysis for determining the contribution of various traits to forage and grain yield.

Materials and Methods

Altogether 168 indigenous and exotic genotypes of cowpea *Vigna unguiculata* (L) walp including three cultigroups i.e. *unguiculata, catjang, sesquipedalis,* and three checks and one control were employed in the experiment at farm of Crop Improvement Division of Indian Grassland and Fodder Research Institute, Jhansi during 2004-05 and 2005-06. The checks were Bundel lobia-1, Bundel lobia-2, UPC-5286 and local control IGFRI-95-1. Augmented block design layout consisted of seven strips with 24 germplasm lines, in each strip. There were two rows

of each germplasm with a spacing of 60 cm from row to row and 100 cm from entry to entry; the plant to plant spacing was kept as 15 cm. The observations were recorded according to minimal descriptor for agri-horti crops (Anonymous, 2007). The data was collected for 29 traits/ parameters from five plants from each line at vegetative, reproductive and harvesting stage. Vegetative traits included, early plant vigour, plant growth habit, plant height, length of main shoot per branch, number of nodes, number of primary branches, number of secondary branches, number of leaves per plant, leaf length, leaf width, leaf weight per plant, stem weight per plant, biomass per plant, fresh leaf per stem ratio, dry leaf weight, dry stem weight, dry weight per plant and dry leaf per stem ratio. Reproductive traits included days to flowering initiation, days to 50 % flowering, days to maturity initiation and days to total maturity. Seed and yield traits included number of pod cluster per plant, number of pods per plant, pod length, seeds per pod, 100 seed weight, seed weight per plant and number of seeds per plant. The data of 29, morphological and seed yield parameters per traits was analyzed for pooled average of both years using SPAR-1 statistical package software. Study of correlation, path analysis of forage and grain yield, yield attributing characters was performed for selection (Snedecor and Cochran, 1967).

Results and Discussion

The correlation was established among different traits of the evaluated germplasm for the pooled data of the years 2004 and 2005. The analysis revealed the highest significant correlation or association between dry weight per plant and dry stem weight per plant (0.9714**); followed by between number of seeds per plant and number of pods per plant (0.9314**); and between biomass per plant and stem weight per plant (0.9624**) as shown in Table.1. The high correlation value of dry stem weight per plant mainly came from positive direct effect (0.4598) of dry weight per plant; stem girth (0.2336); and number of secondary branches (0.2005) as shown in Table 3. Biomass per plant had highly significant positive correlation with dry weight per plant (0.8856**) and days to maturity initiation (0.2035**).

The high correlation value of biomass per plant mainly came from positive direct effect of number of leaves per plant (0.3251); stem girth (0.2842); and number of secondary branches (0.2788) as shown in Table 2. Also stem weight per plant had highly significant positive correlation with dry leaf weight per plant (0.7230**), dry stem weight per plant (0.8856**), biomass per plant (0.9624**), days to maturity initiation (0.2491**), dry weight per plant (0.8956**) and significant positive correlation with days to total maturity (0.1512*). The high correlation value of number of seeds per plant mainly came from direct positive effect of number of pods per plant (0.9059); and through indirect effect of number of pod cluster per plant (0.7718) as shown in Table 4. Similar results were shown by Kohli (2002) and Kumar *et al.* (2001) where correlation studies revealed positive and significant association between seed yield per plant and clusters per plant, pods per plant and 100 seed weight. In this study, days to maturity had the maximum and desirable direct as well as indirect effects on seed yield per plant. This study therefore suggested that selection based on three characters *viz.* 100 seed weight, cluster per plant and pods per plant might bring simultaneous improvement in seed yield. Estimates of the phenotypic and genotypic correlation coefficients, exhibited similar trends as reported by Parmar *et al.* (2003) where, grain yield showed significant positive association with number of clusters per plant and pods per plant at both phenotypic and genotypic levels. Based on the findings it was suggested by Parmar *et. al.* (2003) to lay more emphasis on pods per plant, clusters per plant, seeds per pod, test weight and pods per cluster in selection programmes aiming to improve grain yields in cowpea. In a similar study, Niazi *et al*. (1999) conducted path-coefficient analysis for *Vigna radiata* and concluded that a plant type for increased fodder and grain yield should have higher biomass per plant, dry weight per plant and seed yield per plant. Snedecor and Cochran (1967) described correlation as a measure of association between pairs of variables independent of other variables and path analysis decomposes correlation into pieces for easy interpretation of effects. In their studies with cowpea Yahaya *et al*. (2005) reported a highly significant correlation between plant height and total green pod yield. Also found to be significantly correlated to green pod yield were leaf area per plant. Direct percentage contribution of plant height (20.98 %) was found to be higher to that of leaf area per plant (0.504%), respectively (Yahaya *et al*., 2005). Mary and Gopalan (2006) made association studies for yield and its related traits of fodder cowpea in F_4 generation they also reported that correlations and path analysis aid in the selection of superior genotypes from the breeding population. They observed high positive significant phenotypic and genotypic correlations for traits plant height, number of branches, number of leaves, leaf length, leaf weight, stem weight, green fodder yield and crude protein content. Therefore, in the present study with cowpea, a high impact of direct effects of correlation suggested that going for plant types with higher biomass per plant, dry weight per plant, stem girth, number of secondary branches, number of leaves per plant, number of pods per plant, and number of pod cluster per plant would be effective for improving fodder and seed yield in cowpea.

Table 1 : Correlation coefficients among recorded traits of the pooled data for the years 2004 and 2005

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	1.0000	0.1654*	-0.0510	-0.1031	0.0472	-0.0697	-0.1872*	-0.1321	-0.0800	-0.1054	-0.1967*	-0.1067	0.0264	-0.2128**	-0.1513*
2		1.0000	0.0348	0.0563	0.0216	0.0661	-0.1306	-0.0158	0.0993	0.1489	-0.0225	-0.0337	-0.1030	-0.0148	0.0979
3			1.0000	0.6530**	-0.0302	0.0879	0.1368	0.1420	0.2676**	0.1364	0.3605**	-0.2790**	-0.3692**	-0.0739	0.2617**
4				1.0000	-0.0683	0.1824*	0.1815*	0.1027	0.1877**	0.2166**	0.3201**	-0.2379**	-0.2066**	0.1027	0.2957**
5					1.0000	0.0882	0.2092**	-0.1298	-0.1233	-0.0262	-0.0355	0.1292	0.1023	0.0404	0.0929
6						1	0.1417	0.1144	0.2267**	0.1504	0.1347	-0.0829	-0.0001	0.2283**	0.3344**
7							1.0000	0.2150**	0.1159	0.3494**	0.3786**	0.1284	0.0818	0.3404**	0.4102**
8								1.0000	0.3808*	0.4099**	0.4663**	0.1544*	0.0591	0.3663**	0.3398**
9									1.0000	0.2893**	0.5783**	-0.1233	-0.0782	0.3889**	0.5515**
10										1.0000	0.5024**	0.2477**	0.2026**	0.4845**	0.5739**
11											1.0000	0.0124	-0.0106	0.5661**	0.6325**
12												1	0.7352**	0.2458**	0.0087
13													1.0000	0.2481**	-0.0195
14														1.0000	0.7551**
15															1.0000

Independent variables: 1: Days to 50 per cent flowering; 2: Days to total flowering; 3: Plant height; 4: Number of nodes; 5: Number of primary branches; 6: Number of secondary branches; 7: Stem girth; 8: Number of leaves per plant; 9: Leaf length; 10: Leaf width; 11: Biomass per plant; 12: Fresh leaf per stem ratio; 13: 100seed weight; 14: Days to maturity initiation; 15: Days to total maturity

	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	0.1813*	-0.1203	-0.1865*	-0.1300	-0.1492	-0.0544	-0.0224	-0.1538*	-0.2136**	-0.0561	-0.0293	-0.0471	-0.1162	-0.0668
2	0.0050	0.0684	0.0575	-0.1288	0.0523	-0.0893	0.1533*	-0.0265	0.0192	-0.0654	-0.0636	0.1623*	0.0911	-0.0205
3	0.0548	0.3800**	0.1394	-0.4085**	0.2998**	-0.4119**	0.1392	0.4560**	0.2154**	-0.1943*	-0.3138**	-0.0580	-0.0272	-0.3086**
4	0.1292	0.3728**	0.2347**	-0.1821*	0.3191**	-0.2797**	0.0721	0.7585**	0.3428**	-0.1209	-0.2040**	0.0662	0.0596	-0.1602
5	0.0044	0.0691	0.0771	-0.0863	0.0526	-0.0522	0.0836	-0.0832	-0.1828**	0.0247	0.0255	0.1828*	0.1529*	0.0753
6	0.1631*	0.3143**	0.3118**	-0.1054	0.2870**	-0.1776*	-0.0426	0.0878	0.1636**	-0.0546	-0.0706	0.1343	0.1043	0.0034
7	0.3071**	0.3387**	0.4075**	-0.0245	0.3527**	-0.0379	0.0569	0.1596*	0.0330	0.0362	0.0119	0.0461	0.0767	0.0653
8	0.2863**	0.2832**	0.3725**	0.1216	0.3047**	-0.0606	0.1630*	0.1234	0.1346	0.0256	-0.0341	0.0055	0.0983	-0.0071
9	0.3469**	0.5561**	0.5194**	z-0.1479	0.5270**	-0.2862**	-0.0520	0.1851**	0.0572	-0.2862**	-0.2761**	-0.1240	-0.1681*	-0.2997**
10	0.4801**	0.5046**	0.5735**	-0.0274	0.5329**	-0.1116	0.1949**	0.1743**	0.1906**	0.0341	0.0109	0.0702	0.0398	0.0276
11	0.5423**	0.6898**	0.6454**	0.0459	0.6907**	-0.1613*	0.0087	0.3199**	0.2141**	-0.0662	a-0.0926	-0.0762	-0.0615	-0.0992
12	0.2320**	-0.0613	0.1075	0.3406**	0.0313	0.3211**	0.2270**	-0.2499**	-0.1337	0.1064	0.1268	0.0981	0.0370	0.1407
13	0.1864*	-0.0968	0.0901	0.3869**	-0.0101	0.3461**	0.1039	-0.2043**	-0.1019	0.0678	0.1346	0.0110	-0.0163	0.1305
14	0.8258**	0.6206**	0.9047**	0.4394**	0.7332**	0.1656*	0.1205	0.1006	0.1252	0.0673	0.1232	0.0372	-0.0175	0.1234
15	0.7230**	0.8856**	0.9624**	-0.2036**	0.8956**	-0.2626**	0.1197	0.2491**	0.1512*	-0.0472	-0.0813	0.0776	0.0552	-0.0418
16	1.0000	0.6955**	0.8117**	0.2477**	0.8463**	0.2844**	0.0826	0.1300	0.1057	0.0238	0.0114	0.0265	-0.0377	0.0153
17		1.0000	0.8324**	-0.2364	0.9714**	-0.3967**	0.0959	0.3681**	0.1671*	-0.0964	-0.1266	0.1111	0.1008	-0.0773
18			1	0.0496	0.8856**	-0.1021	0.1277	0.2035**	0.1501*	-0.0028	-0.0018	0.0658	0.0286	0.0240
19				1.0000	-0.0933	0.6176**	0.0138	-0.1051	0.0204	0.1674*	0.3053**	-0.0401	-0.0852	0.2528**
20					1.0000	-0.2000**	0.0984	0.3159**	0.1588*	-0.0636	-0.0901	0.0911	0.0623	-0.0523
21						1.0000	-0.1278	-0.2542**	-0.1112	0.1874*	0.2034**	-0.1391	-0.1649*	0.1475*
22							1.0000	0.0452	0.1711*	0.0391	-0.0194	0.3526**	0.1939*	0.0410
23								1.0000	0.2927**	-0.0822	-0.1278	0.0567	0.0392	-0.1059
24									1	-0.0092	-0.0642	0.1438	0.2264**	0.0128
25										1.0000	0.8520**	0.1884*	0.1564*	0.8220**
26											1.0000	0.1340	0.0729	0.9314**
27												1.0000	0.8029**	0.3801**
28													1.0000	0.3821**
29														1

Independent variables: 16: Dry leaf weight per plant, 17: Dry stem weight per plan, 18: Biomass per plant, 19: Fresh leaf stem ratio, 20: Dry weight per plant, 21: Dry leaf per stem ratio, 22: 100 seed weight, 23: Days to maturity initiation, 24: Days to total maturity, 25: Number of pod clusters per plant, 26: Number of pods per plant, 27: Pod length, 28: Number of seeds per pod, 29: Number of seeds per plant

Table 2 : Path coefficients with biomass per plant as dependent variable

	1	2	3	4	5	6	7	8	9	10
1	**-0.1905**	0.0830	-0.0031	0.0183	-0.0011	0.0746	0.0388	0.1172	-0.0125	0.0149
2	-0.1244	**0.1271**	-0.0070	0.0242	-0.0008	0.0523	0.0616	0.1041	-0.0107	0.0083
3	0.0058	-0.0087	**0.1028**	0.0279	0.0010	-0.0344	-0.0074	-0.0116	0.0058	-0.0041
4	-0.0261	0.0231	0.0215	**0.1335**	-0.0017	0.0323	0.0993	0.1231	0.0058	-0.0033
5	-0.0270	0.0131	-0.0133	0.0287	**-0.0077**	0.1061	0.1165	0.1516	0.0069	-0.0024
6	-0.0510	0.0238	-0.0127	0.0155	-0.0029	**0.2788**	0.0822	0.1880	-0.0055	0.0032
7	-0.0260	0.0275	-0.0027	0.0466	-0.0032	0.0806	**0.2842**	0.1633	0.0111	-0.0082
8	-0.0687	0.0407	-0.0037	0.0505	-0.0036	0.1612	0.1428	**0.3251**	0.0006	0.0004
9	0.0531	-0.0302	0.0133	0.0171	-0.0012	-0.0344	0.0704	0.0040	**0.0449**	-0.0296
10	0.0703	-0.0263	0.0105	0.0109	-0.0005	-0.0218	0.0576	-0.0035	0.0330	**-0.0403**

Independent variables: 1: Days to 50 per cent flowering; 2: Days to total flowering; 3: Plant height; 4: Number of nodes; 5: Number of primary branches; 6: Number of secondary branches; 7: Stem girth; 8: Number of leaves per plant; 9: Leaf length; and 10 : Leaf width

Table 3 : Path coefficients with dry weight per plant as dependent variable

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	**-0.0254**	0.0545	-0.0019	0.0122	0.0064	-0.0150	0.0537	0.0319	0.1658	-0.0269	0.0343	0.0220	-0.0116
2	-0.0166	**0.0834**	-0.0043	0.0253	0.0085	-0.0109	0.0376	0.0506	0.1472	-0.0229	0.0192	0.0098	-0.0079
3	0.000	-0.0057	**0.0628**	0.0122	0.0098	0.0137	-0.0247	-0.0061	-0.0163	0.0125	-0.0095	0.0046	-0.0015
4	-0.0022	0.0152	0.0055	**0.1387**	0.0067	-0.0121	0.0455	0.0351	0.0619	-0.0080	0.0000	0.0057	-0.0050
5	-0.0035	0.0151	0.0131	0.0197	**0.0470**	-0.0227	0.0232	0.0816	0.1741	0.0124	-0.0076	0.0013	-0.0011
6	-0.0036	0.0086	-0.0082	0.0159	0.0101	**-0.1058**	0.0764	0.0958	0.2144	0.0149	-0.0055	-0.0066	-0.0017
7	-0.0068	0.0157	-0.0077	0.0314	0.0054	-0.0403	**0.2005**	0.0676	0.2659	-0.0119	0.0073	0.0080	-0.0081
8	-0.0035	0.0181	-0.0016	0.0209	0.0164	-0.0434	0.0580	**0.2336**	0.2310	0.0239	-0.0188	0.0015	-0.0032
9	-0.0091	0.0267	-0.0022	0.0187	0.0178	-0.0493	0.1160	0.1174	**0.4598**	0.0012	0.0010	-0.0025	-0.0046
10	0.0071	-0.0198	0.0081	-0.0115	0.0060	-0.0163	-0.0247	0.0579	0.0057	**0.0964**	-0.0682	-0.0184	0.0091
11	0.0094	-0.0172	0.0064	0.0000	0.0038	-0.0063	-0.0157	0.0473	-0.0049	0.0709	**-0.0928**	-0.0209	0.0098
12	0.0104	-0.0152	-0.0054	-0.0146	-0.0011	-0.0129	-0.0296	-0.0064	0.0211	0.0328	-0.0359	**-0.0539**	0.0175
13	0.0104	-0.0233	-0.0033	-0.0246	-0.0018	0.0064	-0.0574	-0.0261	-0.0742	0.0309	-0.0321	-0.0333	**0.0283**

Independent variables: 1: Days to 50 per cent flowering; 2: Days to total flowering; 3: Plant height; 4:Length of main branch; 5: Number of nodes; 6: Number of primary branches; 7: Number of secondary branches; 8: Stem girth; 9: Number of leaves per plant; 10: Leaf length; 11: Leaf width; 12: Fresh leaf per stem ratio; and 13: Dry leaf per stem ratio

Table 4 : Path coefficients with number of seeds per plant as dependent variable

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	-0.0383	0.0258	0.0002	0.0046	-0.0018	0.0020	-0.0019	-0.0002	-0.0042	0.0007	0.0015	0.0041	-0.0002	-0.0087	0.0007	0.0003	-0.2843	-0.0005	-0.0083
2	-0.0250	0.0395	0.0005	0.0061	-0.0013	0.0014	-0.0030	-0.0002	-0.0036	0.0004	0.0026	0.0018	-0.0001	-0.0145	0.0010	0.0002	-0.1848	0.0006	0.0182
3	0.0012	-0.0027	-0.0071	0.0071	0.0017	-0.0009	0.0004	0.0000	0.0020	-0.0002	0.0008	0.0009	-0.0001	0.0016	-0.0006	0.0000	0.0231	0.0016	0.0468
4	-0.0052	0.0072	-0.0015	0.0338	-0.0028	0.0009	-0.0048	-0.0002	0.0019	-0.0002	0.0045	0.0002	-0.0001	-0.0031	0.0001	-0.0001	0.0108	0.0004	0.0235
5	-0.0054	0.0041	0.0009	0.0073	-0.0129	0.0029	-0.0056	-0.0003	0.0023	-0.0001	0.0041	-0.0012	-0.0003	-0.0024	0.0004	0.0000	-0.0309	0.0000	0.0301
6	-0.0102	0.0074	0.0009	0.0039	-0.0049	0.0075	-0.0040	-0.0004	-0.0019	0.0002	0.0057	0.0015	0.0001	-0.0035	0.0002	0.0004	-0.2501	-0.0011	-0.0514
7	-0.0052	0.0085	0.0002	0.0118	-0.0053	0.0022	-0.0137	-0.0003	0.0038	-0.0004	0.0063	0.0003	-0.0003	-0.0033	0.0006	0.0000	0.0099	0.0006	0.0122
8	-0.0138	0.0126	0.0003	0.0128	-0.0060	0.0044	-0.0069	-0.0006	0.0002	0.0000	0.0071	-0.0005	0.0000	-0.0061	0.0007	0.0001	-0.0838	-0.0007	-0.0188
9	0.0107	-0.0094	-0.0009	0.0043	-0.0020	-0.0009	-0.0034	0.0000	0.0151	-0.0015	0.0012	-0.0034	-0.0004	0.0048	-0.0004	-0.0002	0.1148	0.0009	0.0113
10	0.0141	-0.0082	-0.0007	0.0028	-0.0008	-0.0006	-0.0028	0.0000	0.0111	-0.0020	0.0010	-0.0039	-0.0002	0.0039	-0.0003	-0.0001	0.1219	0.0001	-0.0050
11	-0.0053	0.0093	-0.0006	0.0138	-0.0048	0.0039	-0.0079	-0.0004	0.0016	-0.0002	0.0110	-0.0005	-0.0002	-0.0039	0.0005	0.0000	-0.0016	0.0006	0.0088
12	0.0156	-0.0072	0.0006	-0.0008	-0.0016	-0.0011	0.0004	0.0000	0.0052	-0.0008	0.0005	-0.0100	0.0000	0.0020	0.0001	-0.0002	0.2765	-0.0004	-0.0261
13	-0.0053	0.0028	-0.0006	0.0019	-0.0021	-0.0004	-0.0027	0.0000	0.0034	-0.0002	0.0014	-0.0001	-0.0017	-0.0009	0.0005	-0.0001	-0.0175	0.0032	0.0593
14	-0.0174	0.0299	0.0006	0.0054	-0.0016	0.0014	-0.0024	-0.0002	-0.0038	0.0004	0.0022	0.0010	-0.0001	-0.0192	0.0009	0.0001	-0.1158	0.0005	0.0120
15	-0.0082	0.0135	0.0013	0.0011	-0.0017	0.0004	-0.0026	-0.0001	-0.0020	0.0002	0.0016	-0.0002	-0.0003	-0.0056	0.0030	0.0000	-0.0582	0.0013	0.0692
16	0.0074	-0.0048	-0.0002	0.0012	-0.0003	-0.0022	-0.0005	0.0000	0.0016	-0.0001	0.0000	-0.0017	-0.0001	0.0016	0.0000	-0.0014	0.7718	0.0017	0.0478
17	0.0120	-0.0081	-0.0002	0.0004	0.0004	-0.0021	-0.0001	0.0001	0.0019	-0.0003	0.0000	-0.0030	0.0000	0.0024	-0.0002	-0.0012	0.9059	0.0012	0.0223
18	0.0022	0.0026	-0.0013	0.0016	-0.0001	-0.0009	-0.0010	0.0000	0.0015	0.0000	0.0007	0.0004	-0.0006	-0.0011	0.0004	-0.0003	0.1213	0.0090	0.2456
19	0.0010	0.0024	-0.0011	0.0026	-0.0013	-0.0013	-0.0005	0.0000	0.0006	0.0000	0.0003	0.0008	-0.0003	-0.0008	0.0007	-0.0002	0.0660	0.0072	0.3059

Independent variables: 1: Days to 50 per cent flowering; 2: Days to total flowering; 3: Plant height; 4: Number of nodes; 5: Number of primary branches; 6: Number of secondary branches; 7: Stem girth; 8: Number of leaves per plant; 9: Leaf length; 10: Leaf width; 11: Biomass per plant; 12: Fresh leaf per stem ratio; 13: 100seed weight; 14: Days to maturity initiation; 15: Days to total maturity; 16: Number of pod clusters per plant; 17: Number of pods per plant; 18: Pod length; and 19: Number of seeds per plant

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