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Studies on correlation and path analysis in Horsegram (*Macrotyloma uniflorum*)

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Abstract
A study entitled "Studies on correlation and path analysis in Horsegram (*Macrotyloma uniflorum*)" was performed at the Instructional cum Research Farm of IGKV CARS RMD, Ajirma, Ambikapur, Surguja (C.G.), during *Kharif* 2021 in randomized block design (RBD) with three replications with twenty-two genotypes of horsegram. A study of correlation and path coefficient analysis for yield and yield attributes were carried out with twelve characters. The correlation analysis indicated that seed yield quintal per hectare exhibited highest significant positive association with number of seeds per pod followed by harvest index (%), 100 seed weight (g), number of clusters per plant, days to 50% flowering, days to maturity and number of pods per plant at genotypic level. Path analysis revealed that highest positive direct effect was exhibited by days to 50% flowering followed by days to maturity, plant height (cm), number of branches per plant, number of clusters per plant, number of seeds per pod, number of pods per cluster, biological yield quintal per hectare and harvest index (%). Harvest index is direct effect and equal to correlation. This suggested that selection for these characters will help in isolating highly yielding genotypes. Thus, these traits may be used as selection criteria for screening of promising horsegram genotypes.

Keywords: Correlation and path analysis, Horsegram

Introduction
Horsegram (*Macrotyloma uniflorum*) is a minor legume crop native to India and widely grown in India. It's a popular arid legume crop among farmers because of its drought tolerance. It is a common short-duration pulse crop with many applications, including grains for cooking and leaves as fodder**.** It grows and flourishes in a wide range of geographical regions with variable levels of water availability, allowing researchers to examine stress tolerance mechanisms in horsegram. Pulses play an important role in agriculture because they not only provide food for humans and feed for cattle but also help to restore soil fertility. Atmospheric nitrogen fixation in their root nodules with the help of symbiotic bacteria such as rhizobium thus increases soil nitrogen content.

Horsegram is being grown in regions with more than 800 mm of average rainfall. Native Indian tribal farmers with limited resources now have the option of growing horsegram in Gujarat, Rajasthan, Karnataka, Odisha, Andhra Pradesh, Tamil Nadu, Bihar, Maharashtra and the uplands of Chhattisgarh and Madhya Pradesh. Horsegram is used as a pulse crop in India, where it makes up around 0.33 % of all food grains produced. It is being cultivated in 283.4 lakh hectare area with, production 23.2 million tonnes and has an average national productivity of 817 kg/ha (Anonymous 2020) [3]. Horsegram is cultivated in an area of 26 thousand hectare in Chhattisgarh, with average productivity of 10.15 thousand tonnes and a production of 390 kg/ha (Anonymous 2019) [2]. Horsegram is mostly cultivated in Surguja, Jashpur, Kanker, Korba, Jagdalpur, Janjgir and tribal dominated area of Chhattisgarh. The local name for horsegram is hirwa, harwa and kulthi. Large communities in rural tribal of India can eat the seed sprout or a full meal of horsegram. The whole seed of horsegram is frequently utilized as cattle feed.

The most important factor in generating genetic variability in crops is the selection of genetically diverse parents for hybridization programme. Since yield is a complex character that is heavily influenced by the environment, direct selection for yield limits selection efficiency. Thus, effective yield improvement can be achieved through the selection of yield component traits. Yield component traits have an association with one another as well as with yield. Knowledge of variability in terms of phenotypic and genotypic coefficients of variation,

genetic advance and heritability is of immense importance in evolvement of superior varieties.

Also it can be used for desired improvement in existing varieties. Correlation is a measure of the degree of closeness and mutual relationship between two variables, large number of genes influence association among different characters. Path analysis makes it easier to separate correlation coefficients into direct and indirect effects of various characters on yield. As a result, knowledge of character associations, as well as the direct and indirect effects that each character has on yield, will be useful in the selection process.

Materials and Methods

The research project on "Studies on correlation and path analysis in Horsegram (*Macrotyloma uniflorum*)" was conducted during *Kharif* 2021 at the Research cum Instructional Farm of IGKV CARS RMD, Ajirma, Ambikapur, Surguja (C.G.), which is located at a latitude of 20°8' N and the longitudinal of 83°15' E, at an altitude of 592.62 meters above mean sea level.

The observation was recorded for twelve characters *viz*., days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, number of clusters per plant, number of seeds per pod, number of pods per plant, number of pods per cluster, 100 seed weight (g), seed yield quintal per hectare, biological yield quintal per hectare and harvest index (%). Correlation coefficients were estimated by formula suggested by Miller *et al*., (1958) [6] and path coefficient analysis by formula suggested by Dewey and Lu (1959) [4].

Results and Discussion

The correlation studies provide us with a general concept of the relationships between the characteristics and the yield. It was observed that the genotypic correlation was higher than the phenotypic correlation, showing that the environment had no impact on the characteristics. In the present investigation, seed yield quintal per hectare was found to be highly significant and positively correlated with number of seeds per pod, harvest index, 100 seed weight, number of clusters per plant, days to 50% flowering, days to maturity and number of pods per plant at genotypic level indicating that these attributes were mainly influencing the seed yield in horsegram. Thus, selection practiced in a character will automatically result in the improvement of other character even though direct selection for improvement has not been made for the yield character. Similar results were also reported by Alle *et al*., (2016) [1], Priyanka *et al*., (2019) [10] and Singh and Salam (2021) [12] for number of seeds per pod, Singh *et al*., (2020) [7] and Pawar *et al*., (2020) [9] for harvest index, Alle *et al*., (2016) [1] and Singh *et al*., (2020) [7] for 100 seed weight, Kulkarni (2011) [5] and Priyanka *et al*., (2019) [10] for number of clusters per plant, Alle *et al*., (2016) [1], Priyanka *et al*., (2019) [10] and Pawar *et al*., (2020) [9] for days to 50% flowering, days to maturity and number of pods per plant. The correlation between all possible combinations among the characters was estimated at genotypic level is presented in Table 1.

The path analysis is done in association with the correlation coefficient into direct and indirect effects. The genotypic correlation coefficients of various characters showed significant association with seed yield were subjected to path analysis to estimate the direct and indirect effects of component traits on seed yield which is considered as the dependent variable in the analysis. The results of direct and indirect effects of various traits concerning seed yield are presented in Table 2. In present study, the path coefficient analysis was carried out at genotypic level. Harvest index (0.676), followed by number of seeds per pod (0.414), number of pods per cluster (0.392), days to 50% flowering (0.325), number of clusters per plant (0.267), biological yield (0.223), plant height (0.094), days to maturity (0.072) and number of branches per plant (0.016) exhibited high positive direct effects on seed yield quintal per plant at genotypic level. The highest negative direct effect was exhibited by 100 seed yield (-0.266) and number of pods per plant (-0.119). Thus, harvest index, number of seeds per pod and days to 50% flowering emerged as most important direct yield contributing characters. Harvest index is direct effect and equal to correlation with seed yield quintal per hectare. Hence, direct selection for these traits would be rewarding for yield improvement, which will also reduce the undesirable effects of the studied component traits. These characters have also been identified as major direct contributors towards seed yield in horsegram by former workers Rama *et al*., (2007) [11] for harvest index, Priyanka *et al*., (2019) [10] and Singh and Salam (2021) [12] for number of seeds per pod, Alle *et al*.,(2016) [1] for number of pods per cluster, days to 50% flowering, Priyanka *et al.,* (2019) [10] for number of clusters per plant, biological yield and plant height, Paliwal *et al*., (2005) [8] for days to maturity, number of branches per plant, whereas, Singh and Salam (2021) [12] for 100 seed weight and Alle *et al*., (2016) [1] and Priyanka *et al*., (2019) [10] for number of pods per plant showed negative direct effect on seed yield quintal per hectare at genotypic level.

Table 1: Genotypic and phenotypic correlation between seed yield and yield attributing characters in horsegram

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branchesper plant	Number of cluster per plant	Number of seeds per pod	Number of pods per plant	Number of pods per cluster	100 Seed weight (g)	Biological yield quintal per hectare	HI (%)	Seed yield quintal per hectare
Days to 50% flowering	1.000	0.432**	0.190	0.309*	0.424**	0.411**	0.253*	-0.397**	0.400**	0.241	0.226	0.578**
Days to maturity	0.403**	1.000	-0.212	0.326**	0.586**	0.061	-0.094	-0.219	0.234	0.190	0.168	0.399**
Plant height (cm)	0.150	-0.181	1.000	-0.554**	0.221	0.233	0.291*	-0.400**	-0.105	0.076	0.143	0.238
Number of branches per plant	0.259*	0.244*	-0.411**	1.000	-0.231	-0.082	-0.060	0.322**	0.438**	0.102	-0.061	-0.009
Number of	0.348**	0.489**	0.168	-0.104	1.000	0.434**	-0.036	-0.369**	0.362**	0.186	0.230	0.605**

cluster per plant												
Number of seeds per pod	0.337**	0.069	0.207	0.065	0.336**	1.000	0.122	-0.168	0.647**	0.327**	0.362**	0.754**
Number of pods per plant	0.228	-0.071	0.230	-0.012	-0.008	0.012	1.000	-0.329**	-0.237	-0.614**	0.628**	0.246*
Number of pods per cluster	-0.298*	-0.158	-0.306*	0.195	-0.195	-0.024	-0.280*	1.000	0.398**	0.187	-0.169	-0.092
100 Seed weight (g)	0.370**	0.206	-0.114	0.334	0.307*	0.497**	-0.211	0.314	1.000	0.407**	0.130	0.606**
Biological yield quintal per hectare	0.228	0.182	0.076	0.087	0.121	0.283*	-0.531**	0.136	0.367**	1.000	-0.545**	0.180
HI (%)	0.219	0.164	0.138	-0.053	0.192	0.280*	0.560**	-0.129	0.129	-0.543**	1.000	0.688**
Seed yield quintal per hectare	0.558**	0.389**	0.224	-0.013	0.487**	0.612**	0.233	-0.080	0.573**	0.194	0.679**	1.000

Note: **Significant at 1 % level, *Significant at 5 % level

Table 2: Genotypic direct (diagonal) and indirect effects of 12 characters on seed yield in 22 genotypes of horsegram

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of cluster per plant	Number of seeds per pod	Number of pods per plant	Number of pods per cluster	100 Seed weight (g)	Biological yield quintal per hectare	HI (%)	Seed Yield quintal per hectare
Days to 50% flowering	0.325	0.031	0.018	0.005	0.113	0.170	-0.030	-0.156	-0.106	0.054	0.153	0.578**
Days to maturity	0.141	0.072	-0.020	0.005	0.156	0.025	0.011	-0.086	-0.062	0.043	0.113	0.399**
Plant height (cm)	0.062	-0.015	0.094	-0.009	0.059	0.096	-0.035	-0.157	0.028	0.017	0.097	0.238
Number of branches per plant	0.100	0.024	-0.052	0.016	-0.062	-0.034	0.007	0.126	-0.116	0.023	-0.041	-0.009
Number of clusters per plant	0.138	0.042	0.021	-0.004	0.267	0.180	0.004	-0.144	-0.096	0.042	0.156	0.605**
Number of seeds per pod	0.134	0.004	0.022	-0.001	0.116	0.414	-0.015	-0.066	-0.172	0.073	0.245	0.754**
Number of pods per plant	0.082	-0.007	0.027	-0.001	-0.010	0.051	-0.119	-0.129	0.063	-0.137	0.425	0.246*
Number of pods per cluster	-0.129	-0.016	-0.038	0.005	-0.098	-0.070	0.039	0.392	-0.106	0.042	-0.114	-0.092
100 Seed weight (g)	0.130	0.017	-0.010	0.007	0.097	0.268	0.028	0.156	-0.266	0.091	0.088	0.606**
Biological yield quintal per hectare	0.079	0.014	0.007	0.002	0.050	0.135	0.073	0.073	-0.108	0.223	-0.368	0.180
HI (%)	0.074	0.012	0.014	-0.001	0.061	0.150	-0.075	-0.066	-0.035	-0.122	0.676	0.688**

Residual effect = 0.0079

Conclusion

Number of seeds per pod, harvest index, 100 seed weight, number of clusters per pod, days to 50% flowering, days to maturity, and number of pods per plant had positive genotypic correlation with seed yield. Path coefficient analysis recorded that harvest index, number of seeds per pod, number of pods per cluster, days to 50% flowering, number of clusters per plant, biological yield, plant height, days to maturity, and number of branches per plant showed positive direct effect on seed yield quintal per hectare at genotypic level. These are the important yield component in the present study on horsegram.

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