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Trait Association Analysis for Yield and its Components in Indian Mustard (*Brassica juncea* L.)

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ABSTRACT: Present study carried out with total sixty eight genotypes includes 50 hybrids, 10 *mori* CMS lines, five restores and three checks (RH-30, RH-0749 and DMH-1) of Indian mustard. These genotypes were evaluated for seed yield and its yield components for eleven characters during Rabi season of 2018-19 at Oilseeds Research Area, Chaudhary Charan Singh Haryana Agricultural University, Hisar. The results revealed that plant height, number of primary branches/plant, number of secondary branches/plant, main shoot length, number of siliquae on main shoot and number of seeds/siliquae have significant positive association with seed yield/plant. Genotypic correlation between number of siliquae on main shoot and seed yield per plant was found highest (0.704) indicates direct selection based on number of siliquae on main shoot will be rewarding in selection of high seed yield genotypes. Path coefficient at genotypic level showed that number of secondary branches (0.448) and number of siliquae on main shoot (0.367) had the highest positive direct effects on seed yield/plant. The characters identified above as important direct and indirect yield components in formulating effective selection strategy for developing high yielding mustard genotypes.**

Keywords: Path coefficient, correlation coefficient, seed yield, character association, Indian mustard.

INTRODUCTION

Indian mustard (*Brassica juncea* L.) belongs to the family cruciferae. The Indian mustard is commonly known as raya and cytologically it is an amphidiploid crop (2n=36) derived from natural chromosomal doubling of interspecific cross between *Brassica nigra* (2n=16) and *Brassica campestris* (2n=20). Among rapeseed-mustard species, four species viz. *Brassica juncea, B. napus, B. rapa* and *B. carinata* are cultivated in about 6.23 million hectares area and produce 9.25 million tons in India (FAOSTAT, 2020). *Brassica juncea* is the major rabi oilseed crop of India and accounts for about 75-80 % of the total rapeseed-mustard area and production. Among the nine major oilseed crops widely grown in India, rapeseed-mustard occupies the second most important position after soybean because of its greater sustainability and adaptability under varied agro-ecological situations. India is ranked 3rd in world after Canada and China both in acreage (19.3%) and production (11.3%) of brassica oilseeds. (Singh *et al*., 2020). In India, Rapeseed-mustard is ranked 2nd in both acreage (23.33%) and production (26.24%) after Soybean (Jat *et al*., 2019). Now a days, increase in the productivity and oil content of brassica oilseed are the most important breeding aspects.

Yield is a complex polygenic trait and more prone to environmental fluctuations than other yield component traits such as branches per plant, main shoot length, number of siliquae on main shoot, siliqua length and seeds per siliqua. Thus, the selection based on seed yield/plant via its component traits is more effective. Hence, knowledge of association of the yield component traits with each other would be quite valuable in developing a crop improvement selection criteria. The importance of yield components in improving yield per se, which is a dependent variable on these features, was well demonstrated in association studies in several other crops (Moosavi *et al*., 2015; Roy *et al*., 2021; Kumar *et al.,* 2021). Correlation indicates the degree of association between characters, although it is widely recognised that it doesn't meet the researcher's objectives because it does not detect characters that have indirect influence on seed yield. In such conditions Wright's (1921) path coefficient analysis demonstrated the singnificant importance of such characters as dividing the correlation coefficient into direct and indirect effects. As a result, the current study aims to determine the interrelationships and contributions of different component traits to seed yield in order to develop high-yielding cultivars in Indian mustard.

MATERIAL AND METHODS

In this study, we used 68 Indian mustard genotypes, including 15 parental lines, 50 F_1 hybrids and two varieties (RH 30 and RH 0749) and one hybrid (DMH-1) as standard checks (table 1). All these 68 genotypes were raised in RBD Design with three replications during Rabi season, 2018-19 at Oilseeds Research Farm, Department of Genetics and Plant Breeding, CCS HAU, Hisar. These genotypes were planted in 5m long paired rows plots with a 30 cm inter-row spacing and a 10 cm intra-row spacing. To raise a productive harvest, all of the suggested packages and techniques were used. The data were collected on the following 11 traits *viz*. days to 50% flowering and days to maturity were recorded on plot basis while other phenotypic traits were recorded from the five randomly selected and tagged plants from the centre of each row as follows: plant height, number of primary branches/plant, number of secondary branches/plant, main shoot length, number of siliquae on main shoot, siliqua length, number of seeds/siliqua, test weight (g) and seed yield/plant (g).

Statistical analysis: These traits were computed using mean data and after computing, each character was subjected to estimate genotypic and phenotypic correlation coefficients (Al-Jibouri *et al.,* 1958) and path analysis was carried out using the genotypic correlation coefficient to know direct and indirect effects of the components on yield as suggested by Wright (1921) and demonstrated by Dewey and Lu (1957). The seed yield/plant (SYP) was considered as response variable whereas days to flowering (DF), days to maturity (DM), plant height (PH), number of primary branches (NPB), number of secondary branches (NSB), main shoot length (MSL), number of siliquae on main shoot (NSMS), siliqua length (SL) and number of seeds/siliqua (NSPS) were considered as casual variable. All the statistical analysis was performed using OPSTAT Online Statistical Package (CCS HAU, Hisar).

Table 1: **List of 68 Indian mustard genotypes (50 F_1s, 3 checks, 10 *mori* CMS lines and 5 restores)**

Sr. No.	Genotype	Sr. No.	Genotype	Sr. No.	Genotype	Sr. No.	Genotype
1.	MA-1-30 × MR-9	**18.**	MA-8701 × MR-38	**35.**	MA-9301 × MR-44	**52.**	RH-0749
2.	MA-1-30 × MR-31	**19.**	MA-8701 × MR-43	**36.**	MA-9518 × MR-9	**53.**	RH-30
3.	MA-1-30 × MR-38	**20.**	MA-8701 × MR-44	**37.**	MA-9518 × MR-31	**54.**	MA-1-30
4.	MA-1-30 × MR-43	**21.**	MA-8812 × MR-9	**38.**	MA-9518 × MR-38	**55.**	MA-023
5.	MA-1-30 × MR-44	**22.**	MA-8812 × MR-31	**39.**	MA-9518 × MR-43	**56.**	MA-270
6.	MA-023 × MR-9	**23.**	MA-8812 × MR-38	**40.**	MA-9518 × MR-44	**57.**	MA-8701
7	MA-023 × MR-31	**24.**	MA-8812 × MR-43	**41.**	MA-9811 × MR-9	**58.**	MA-8812
8	MA-023 × MR-38	**25.**	MA-8812 × MR-44	**42.**	MA-9811 × MR-31	**59.**	MA-9705
9	MA-023 × MR-43	**26.**	MA-9705 × MR-9	**43.**	MA-9811 × MR-38	**60.**	MA-9301
10	MA-023 × MR-44	**27.**	MA-9705 × MR-31	**44.**	MA-9811 × MR-43	**61.**	MA-9518
11	MA-270 × MR-9	**28.**	MA-9705 × MR-38	**45.**	MA-9811 × MR-44	**62.**	MA-9811
12	MA-270 × MR-31	**29.**	MA-9705 × MR-43	**46.**	MA-9702 × MR-9	**63.**	MA-9702
13	MA-270 × MR-38	**30.**	MA-9705 × MR-44	**47.**	MA-9702 × MR-31	**64.**	MR-9
14	MA-270 × MR-43	**31.**	MA-9301 × MR-9	**48.**	MA-9702 × MR-38	**65.**	MR-31
15	MA-270 × MR-44	**32.**	MA-9301 × MR-31	**49.**	MA-9702 × MR-43	**66.**	MR-38
16	MA-8701 × MR-9	**33.**	MA-9301 × MR-38	**50.**	MA-9702 × MR-44	**67.**	MR-43
17	MA-8701 × MR-31	**34.**	MA-9301 × MR-43	**51.**	DMH – 1	**68.**	MR-44

RESULT AND DISCUSSION

A. Correlation analysis

The results of phenotypic and genotypic correlation coefficients between yield and its component traits is presented in Table 2. Magnitudes of genotypic correlation coefficients for most of the traits were higher than their respective phenotypic correlation coefficients, which indicate the presence of inherent or genetic association among various traits. Therefore, selection on the basis of the phenotype would be effective. Many previous studies found that phenotypic correlation coefficients were smaller than genotypic correlation coefficients among various variables in Indian mustard (Priyamedha *et al*., 2018; Pandey *et al*., 2020). Seed yield in mustard is the result of many component traits which are interdependent as well as the environment dependent. The present study found positive and significant genotypic correlations between seed yield per plant and plant height (0.46^{**}), number of primary branches (0.51**), number of secondary branches (0.65**), main shoot length (0.51**), number of siliquae on main shoot (0.70**) and number of seeds per siliqua (0.55**). This suggests that indirect selection through these component traits will result in seed yield improvement. Similarly, many previous studies revealed the strong association of these traits with seed yield in Indian mustard (Sheker *et al*., 2012; Sirohi *et al*., 2015; Kumar *et al*. 2016; Priyamedha *et al*., 2018; Monika *et al*., 2019; Pandey *et al*., 2020). Besides this, days to flowering (-0.01^{NS}) and days to maturity (-0.07^{NS}) exhibits negative association with seed yield, is desirable because early flowering provide shorter vegetative phase and longer reproductive phase with more grain filling time while the development of high yielding and early maturing varieties is the prime objective of breeders in Indian mustard.

Besides the seed yield per plant, plant height had positive and significant genotypic and phenotypic correlation with number of primary branches (0.34**, 0.26**), main shoot length (0.40**, 0.33**), number of siliquae on main shoot (0.61**, 0.47**), number of seeds per siliqua (0.24**, 0.21**), days to flowering

(0.43**, 0.41**) and seed yield (0.46**, 0.42**) while test weigth (0.14*) found significant only for genotypic correlation. Number of primary branches had positive and significant genetic and phenotypic association with number of secondary branches (0.56**, 0.50**), number of siliquae on main shoot (0.33**, 0.23**), number of seeds per siliqua (0.38**, 0.34**) and seed yield per plant (0.51**, 0.41**). Number of secondary branches were positive and significantly correlated with main shoot length (0.20**, 0.21**), number of siliquae on main shoot (0.29**, 0.25**), number of seeds per siliqua (0.37**, 0.37**) and seed yield per plant (0.65**, 0.58**). Main shoot length had positive and significant genetic and phenotypic correlation with number of siliquae on main shoot (0.79**, 0.71**), siliqua length (0.28**, 0.31**) and seed yield per plant (0.51**, 0.45**). Number of siliquae on main shoot had positive correlation with siliquae length (0.16*, 0.17*), number of seeds per siliqua (0.28**, 0.22**) and seed yield per plant (0.70**, 0.55**). Previously, Mahla *et al.*, 2003; Kumar *et al.*, 2019; Nandi *et al*., 2021 were also reported positive correlation between plant height, main branch length, number of branches per plant, siliqua on main branch, seeds per siliqua and seed yield per plant.

Genotypic correlation between number of siliquae on main shoot and seed yield per plant was found highest (0.70**) indicates selection based on number of siliquae on main shoot will be rewarding in selection of high seed yield genotypes. Siliqua length had positively correlated with number of seeds per Siliquae and test weight. Days to 50% flowering, days to maturity and test weight showed the positive correlation with each other but negative correlation with other remaining eight traits. Similar pattern of correlation among yield and component traits have also been previously reported by Singh (2010); Kumar *et al*. (2016); Priyamedha *et al*. (2018); Monika *et al*. (2019); Pandey *et al*. (2020). Hence, direct selection for these traits would be rewarding for yield improvement in Indian mustard.

Table 2: Genotypic (below diagonal) and phenotypic (above diagonal) correlation coefficients among yield and its component traits in Indian mustard.

Character	PH	NPB	NSB	MSL	NSMS	SL	NSS	DF	DM	TW	SYP
PH	1	0.26^{**}	0.02^{NS}	0.33^{**}	0.47^{**}	0.12^{NS}	0.21^{**}	0.41^{**}	0.06^{NS}	0.12^{NS}	0.42^{**}
NPB	0.34^{**}	1	0.50^{**}	0.09^{NS}	0.23^{**}	0.07^{NS}	0.34^{**}	0.08^{NS}	-0.15^{*}	-0.09^{NS}	0.41^{**}
NSB	0.03^{NS}	0.56^{**}	1	0.21^{**}	0.25^{**}	0.02^{NS}	0.37^{**}	-0.07^{NS}	-0.20^{**}	-0.26^{**}	0.58^{**}
MSL	0.40^{**}	0.13^{NS}	0.20^{**}	1	0.71^{**}	0.31^{**}	0.15^{*}	-0.17^{*}	-0.09^{NS}	0.02^{NS}	0.45^{**}
NSMS	0.61^{**}	0.33^{**}	0.29^{**}	0.79^{**}	1	0.17^{*}	0.22^{**}	0.03^{NS}	0.01^{NS}	-0.04^{NS}	0.55^{**}
SL	0.13^{NS}	0.03^{NS}	-0.02^{NS}	0.28^{**}	0.16^{*}	1	0.36^{**}	-0.11^{NS}	-0.04^{NS}	0.25^{**}	0.13^{NS}
NSS	0.24^{**}	0.38^{**}	0.37^{**}	0.11^{NS}	0.23^{**}	0.37^{**}	1	-0.17^{*}	-0.31^{**}	-0.28^{**}	0.53^{**}
DF	0.43^{**}	0.08^{NS}	-0.08^{NS}	-0.19^{**}	0.06^{NS}	-0.12^{NS}	-0.17^{*}	1	0.51^{**}	0.22^{**}	-0.02^{NS}
DM	0.07^{NS}	-0.18^{**}	-0.24^{**}	-0.09^{NS}	0.06^{NS}	-0.04^{NS}	-0.33^{**}	0.54^{**}	1	0.32^{**}	-0.08^{NS}
TW	0.14^{*}	-0.11^{NS}	-0.32^{**}	0.02^{NS}	-0.05^{NS}	0.26^{**}	-0.33^{**}	0.23^{**}	0.34^{**}	1	-0.20^{**}
SYP	0.46^{**}	0.51^{**}	0.65^{**}	0.51^{**}	0.70^{**}	0.12^{NS}	0.55^{**}	-0.01^{NS}	-0.07^{NS}	-0.22^{**}	1

*Significant at $P \leq 0.05$ and **Significant at $P \leq 0.01$; PH-Plant Height (cm); NPB-No. of Primary Branches; NSB-No. of Secondary Branches; MSL-Main Shoot Length (cm), NSMS-No. of Siliquae on Main Shoot; SL-Siliqua Length (cm); NSS-No. of Seeds/Siliqua; DF-Days to Flowering (50 %); DM-Days to Maturity; TW-1000-Seed Weight (g); SYP-Seed Yield/Plant (g).

Path coefficient analysis: The estimates of direct and indirect effects of different character on grain yield per plant are presented in Table 3. The presence of a substantial phenotypic and genotypic correlation indicated that a character could be used for indirect selection. However, these correlations may be due pleiotropic effects, gene linkages and environmental influences. As a result, from a practical and decision-making standpoint, it was preferable to determine the direct phenotypic effects using the most appropriate selection criteria. The examination of path coefficients provided precise information on the relative importance of the characteristics involved, as well as their direct and indirect effects. Path analysis partitioning the total correlation coefficient into direct and indirect effects, and measures the relative importance of the casual factor individually, which is useful in identifying target traits for yield improvement (Mengistu *et al*., 2020). In the present study, number of secondary branches (0.448) and number of siliquae on main shoot (0.367) had the highest positive direct effects on seed yield/plant. This indicates the prime importance of these traits for direct selection. The other five traits viz; plant height (0.16), main shoot length (0.04), number of seeds per siliquae (0.13), days to maturity (0.16) and test weight (0.02) also showed the positive direct effect on seed yield per plant at genotypic level. Previously, Kumar *et al*. (2019) and Nandi *et al*. (2019) also reported the same finding in Indian mustard. While, days to 50% flowering (-0.112) and siliqua length (-0.109) had highest negative direct effect on yield. This indicates the prime importance of these traits for indirect selection. Similar findings were also reported by Pandey *et al.* (2020), who studied 40 accessions of Indian mustard germplasm using path analysis and found the highest direct effects on seed yield were influenced by plant height and 1000-seed weight. In a separate study involving 12 Indian mustard germplasm lines, Devi (2018) reported that days to 50% flowering had the greatest positive direct effect on seed yield, but the biological yield per plant had the greatest indirect effect.

Table 3: Path coefficient based on genotypic correlation analysis of yield component traits indicating direct effect (diagonal and bold) and indirect effect (above and below diagonal) on seed yield.

Character	PH	NPB	NSB	MSL	NSMS	SL	NSS	DF	DM	TW
PH	**0.169**	-0.006	0.015	0.019	0.225	-0.014	0.084	-0.048	0.012	0.003
NPB	0.058	**-0.017**	0.252	0.006	0.121	-0.003	0.134	-0.009	-0.030	-0.002
NSB	0.005	-0.009	**0.448**	0.009	0.109	0.002	0.128	0.009	-0.040	-0.006
MSL	0.068	-0.002	0.090	**0.048**	0.291	-0.031	0.040	0.021	-0.016	0.001
NSMS	0.104	-0.005	0.133	0.038	**0.367**	-0.018	0.081	-0.006	0.010	-0.001
SL	0.022	-0.001	-0.010	0.013	0.061	**-0.109**	0.130	0.014	-0.008	0.006
NSS	0.022	-0.001	-0.010	0.014	0.062	-0.109	**0.130**	0.014	-0.008	0.006
DF	0.073	-0.002	-0.040	-0.009	0.022	0.013	-0.060	**-0.112**	0.089	0.005
DM	0.013	0.003	-0.109	-0.005	0.023	0.005	-0.114	-0.060	**0.165**	0.007
TW	0.025	0.002	-0.144	0.001	-0.021	-0.030	-0.115	-0.026	0.057	**0.021**

Residual: 0.18707

Where, PH-Plant Height (cm); NPB-No. of Primary Branches; NSB-No. of Secondary Branches; MSL-Main Shoot Length (cm), NSMS-No. of Siliquae on Main Shoot; SL-Siliqua Length (cm); NSS-No. of Seeds/Siliqua; DF-Days to Flowering (50 %); DM-Days to Maturity and TW-1000-Seed Weight (g).

CONCLUSION

Seed yield per plant was positively and significantly correlated with plant height, number of primary branches, number of secondary branches, main shoot length, number of siliquae on main shoot and number of seeds per siliqua at both genotypic and phenotypic levels. The strongest genotypic association between the number of siliquae on the main shoot and seed yield per plant (0.704**), indicating that indirect selection based on the number of siliquae on the main shoot will be beneficial in the selection of high seed yield genotypes. Other characters that have a significant positive association between yield and important yield components would be extremely effective and efficient in increasing their respective traits. Path coefficient analysis identified as the number of secondary branches per plant and number of siliquae on main shoot had the highest positive direct effects on seed yield/plant. Characters listed above as essential direct and indirect yield components in producing high yielding mustard genotypes and these may use to design an effective selection strategy. Thus, selection of genotypes based on the associated character will be useful in development of elite breeding lines.

FUTURE SCOPE

This study will help to understand the trait association between the yield contributing traits and selection based on these traits will be helpful in the identification of superior genotypes of Indian mustard.

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Conflict of Interest. None.

REFERENCES

Al-Jibouri, H. A., Miller, P. A. and Robinson, H. F. (1958). Genotypic and environmental variances and covariances in an upland Cotton cross of interspecific origin. *Agronomy journal*, *50*(10): 633-636.

Devi, B. (2018). Correlation and Path analysis in Indian mustard (*Brassica juncea* L.) in agro-climatic condition of Jhasi (U.P.). *Journal of Pharmacognosy and Phytochemistry*, *7*(1): 1678-1681.

Dewey, D. R. and Lu, K. (1959). A Correlation and Path Coefficient Analysis of Components of Crested Wheatgrass Seed Production. *Agronomy journal*, *51*(9): 515-518.

FAO Statistics (2020). FAOSTAT Statistics Division. Food and Agriculture Organization of the United Nations (https://www.fao.org/faostat/en/#country).

Jat, R. S., Singh, V. V., Sharma, P. and Rai, P. K. (2019). Oilseed brassica in India: Demand, supply, policy perspective and future potential. *OCL*, *26*, 8.

Kumar, R., Kaur, R. and Kaur, L. (2019). Genetic variation for yield traits of F_1 hybrids in Indian mustard (*Brassica juncea* L.). *Journal of Oilseed Brassica*, *10*(2): 117-121.

Kumar, D., Chaudhary, D., Bhardwaj, R., Dogra, R., Chauhan, A., Kumar, S., Shiwani, K. and Chandel, V. G. S. (2021). Correlation and Genetic Divergence Studies of Cauliflower (*Brassica oleracea* var. botrytis) under Lower Hilly Region of Himachal Pradesh. *Biological Forum – An International Journal*, *13*(1): 762-767.

Kumar, R., Gaurav, S. S., Jayasudha, S. and Kumar, H. (2016). Study of correlation and path coefficient analysis in germplasm lines of Indian mustard (*Brasica juncea* L.). *Agricultural Science Digest-A Research Journal*, *36*(2): 92-96.

Mengistu, G., Shimelis, H., Laing, M., Lule, D. and Mathew, I. (2020). Genetic variability among Ethiopian sorghum landrace accessions for major agro-morphological traits and anthracnose resistance. *Euphytica*, *216*(7): 1-15.

Monika, R. C. Y., Yadav, N. R., Avtar, R. and Singh, D. (2019). Phenological trait evaluation and correlation studies for yield and its components in parents and F_2 progeny lines of Indian mustard (*Brassica juncea* L.). *Journal of Oilseed Brassica*, *10*(1): 14-20.

Moosavi, M., Ranjbar, G., Zarrini, H. N., and Gilani, A. (2015). Correlation between morphological and physiological traits and path analysis of grain yield in rice genotypes under Khuzestan conditions. *Biological Forum – An International Journal*, *7*(1): 43-47.

Mahla, H. R., Jambhulkar, S. J., Yadav, D. K., & Sharma, R. (2003). Genetic variability, correlation and path analysis in Indian mustard [*Brassica juncea* (L.) Czern and Coss.]. *Indian Journal of Genetics and Plant Breeding*, *63*(2): 171-172.

Nandi, S., Rout, S., Sur, B., Chakraborty, M., Hijam, L., Roy, S. K. and Gupta, A. (2021). Assessment of Genetic Parameters, Trait Association and Diversity Analysis in Indian mustard [*Brassica juncea* (L.) Czern and

Coss]. *Biological Forum – An International Journal*, *13*(2): 95-109.
Pandey, S. K., Srivastava, K. K., Negi, S., Khan, N. A. and Singh, R. K. (2020). Variability, trait relationship and path analysis for seed yield and seed quality parameters in Indian mustard (*Brassica juncea* L.). *Journal of Oilseed Brassica*, *11*(1): 69-76.
Panse V. G. and Sukhatme, P. V. (1967). *Statistical methods for Agriculture workers* (2nd ed.). Indian council of Agriculture, New Delhi.
Priyamedha, Z. A., Kumar, A., Ram, B., Kumar, A., Singh, V. V. and Rai, P. K. (2018). Analysis of genetic parameters and correlation for yield and quality traits in Indian mustard (*Brassica juncea* L.). *Journal of Oilseed Brassica*, 146-150.
Roy, A., Ahamed, Lal., Babu, J. D. P. Amaravathi, Y., Viswanath, K. and Sreekanth, B. (2021). Correlation and Path Coefficient Analysis in Groundnut (*Arachis hypogaea* L.). *Biological Forum – An International Journal*, *13*(1): 708-712.
Sheker, R., Chauhan, M. P., Singh, M. and Partap, N. (2012). Genetic variability, heritability, genetic advance and character association in Indian mustard [*B. juncea* (L.) Czern & Coss.]. *Plant Arch.*, *12*: 105-107.
Singh, S. K. and Singh, A. K. (2010). Inter-relationship and path analysis for seed yield in Indian mustard. *Indian Journal of Ecology*, *37*(1): 8-12.
Singh, M., Avtar, R., Pal, A., Punia, R., Singh, V. K., Bishnoi, M., Singh, A., Choudhary, R. R. and Mandhania, S. (2020). Genotype-Specific Antioxidant Responses and Assessment of Resistance Against *Sclerotinia sclerotiorum* Causing Sclerotinia Rot in Indian Mustard. *Pathogens*, *9*(11): 892.
Sirohi, S. P. S, Malik, S. and Kumar, K. (2015). Correlation and path analysis of Indian mustard [*B. juncea* (L.) Czern & Coss.]. *Ann. Agri. Res.*, *25*: 491-494.
Wright, S. (1921). Correlation and causation. *J. Agric. Res*., *1*(20): 557-585.

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