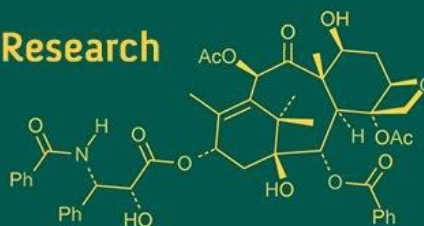


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Correlation studies for seed longevity and its related traits in soybean [*Glycine max* (L.) Merrill]

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Abstract

The present investigation was undertaken to study the correlation of seed longevity and its related traits in soybean through simple correlation analysis. The $F_{1:2}$ seeds of cross DS-228 $\times$ MACS-450 were used to determine correlation of seed longevity and its related traits. The seed coat permeability was positively and significantly correlated with peroxidase, lipid peroxidase and ascorbate peroxidase. The seed density was positively and significantly correlated with accelerated aging test (AAT), initial germination test, lignin content, seed mechanical strength and catalase. The peroxidase was positively and significantly correlated with lipid peroxidase and ascorbate peroxidase. The ascorbate peroxidase was positively and significantly correlated with lipid peroxidase. The lipid peroxidase was negatively and significantly correlated with accelerated aging test, initial germination test, lignin content, seed mechanical strength and catalase. The seed mechanical strength was positively and significantly correlated with accelerated aging test, initial germination test and lignin content.

Keywords: Soybean, correlation, seed longevity, germination, biochemical

Introduction

The soybean [*Glycine max* (L.) Merrill] is an important oilseed crop contributing to 30 percent of world's edible oilseed production. India ranks fifth among major soybean growing countries in the world with 12.92 m ha of cultivated area producing 12.61 mt at a productivity of 976 kg ha⁻¹ (INDIASTAT, 2020-21). Due in part to the excellent nutritional value of soybean as a food source for humans and cattle as well as their importance as an industrial commodity, soybean production is increasing substantially. In a very short period of time, the crop was adopted by farmers as major *kharif* crop in Madhya Pradesh and afterwards the acreage increased in Maharashtra, Rajasthan, Chhattisgarh, Karnataka, Gujarat and Telangana. On an average Madhya Pradesh and Maharashtra produce 51 and 33 per cent of total production of soybean respectively. Seed longevity assumes a key role in preserving the seed fitness during storage under ambient conditions. However, maintaining seed longevity is challenging in soybean given its inherent shorter life span besides meager understanding of the mechanisms regulating seed longevity during late maturation (Shelar *et al.*, 2008) [7]. Poor seed longevity leads to unexpected losses in seed viability during storage, negatively impacts seedling establishment and ultimately affects crop yield (Walters, 1998) [9].

Materials and Methods

The present investigation was conducted at Post Graduate Research Farm of Department of Agricultural Botany and Department of Agricultural Biochemistry, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar (MS) during the period from 2019-2020. The cross DS-228 $\times$ MACS-450 was effected in early Summer 2020 to produce the F_1 seeds and its $F_{1:2}$ seeds advancement were attempted in *Kharif* 2020 and these $F_{1:2}$ seeds were used to determine correlation of seed longevity and its related traits. The characters *viz.*, seed coat proportion, seed coat permeability, accelerated aging test (AAT), initial germination test, lignin content, seed mechanical strength, catalase and seed density were analysed in this study.

Simple correlation coefficient was calculated using variances and co-variances and phenotypic correlations were calculated according to the method given by Singh and Choudhary (1986) [8].

Results and Discussion

The correlation analysis results of cross DS-228 × MACS-450 revealed that seed coat proportion was positively and significantly correlated with accelerated aging test (AAT), initial germination test, lignin content, seed mechanical strength, catalase and seed density. The seed coat proportion was negatively and significantly correlated with seed coat permeability, peroxidase, lipid peroxidase and ascorbate peroxidase (Naik *et al.*, 2016) [6].

The seed coat permeability was positively and significantly correlated with peroxidase, lipid peroxidase and ascorbate peroxidase. The accelerated aging test (AAT), initial germination test, lignin content, seed mechanical strength, catalase and seed density was negatively and significantly correlated for seed coat permeability (Kuchlan *et al.*, 2010; Naik *et al.*, 2016) [5, 6].

The seed density was positively and significantly correlated with accelerated aging test (AAT), initial germination test, lignin content, seed mechanical strength and catalase. The peroxidase, lipid peroxidase and ascorbate peroxidase were negatively and significantly correlated for seed density (Adsul *et al.*, 2018) [1].

The peroxidase was positively and significantly correlated with lipid peroxidase and ascorbate peroxidase. The accelerated aging test (AAT), initial germination test, lignin content, seed mechanical strength and catalase was

negatively and significantly correlated for peroxidase (Kuchlan *et al.*, 2006) [4].

The ascorbate peroxidase was positively and significantly correlated with lipid peroxidase. The accelerated aging test (AAT), initial germination test, lignin content, seed mechanical strength and catalase was negatively and significantly correlated for peroxidase (Bailly *et al.*, 1996) [2].

The lipid peroxidase was negatively and significantly correlated with accelerated aging test (AAT), initial germination test, lignin content, seed mechanical strength and catalase (Bailly *et al.*, 1998) [3].

The catalase was negatively and significantly correlated with accelerated aging test (AAT), initial germination test, lignin content and seed mechanical strength. (Kuchlan *et al.*, 2006) [4].

The seed mechanical strength was positively and significantly correlated with accelerated aging test (AAT), initial germination test and lignin content (Kuchlan *et al.*, 2010) [5].

The lignin content was positively and significantly correlated with accelerated aging test (AAT) and initial germination test.

The initial germination test was positively and significantly correlated with accelerated aging test (AAT) (Naik *et al.*, 2016) [6].

Table 1: Simple correlation for seed longevity related traits in cross DS-228 (Phule Kalyani) × MACS-450

	Seed coat proportion	Seed coat permeability	Seed density	Peroxidase	Ascorbate peroxidase	Lipid peroxidase	Catalase	Mechanical strength	Lignin	Int. Germ. test	AAT
Seed coat proportion	1	-0.741**	0.869**	-0.859**	-0.813**	-0.886**	0.489**	0.812**	0.903**	0.676**	0.631**
Seed coat permeability		1	-0.658**	0.621**	0.604**	0.643**	-0.383**	-0.655**	-0.647**	-0.723**	-0.726**
Seed density			1	-0.745**	-0.733**	-0.787**	0.413**	0.789**	0.798**	0.626**	0.597**
Peroxidase				1	0.839**	0.915**	-0.482**	-0.734**	-0.955**	-0.564**	-0.532**
Ascorbate peroxidase					1	0.913**	-0.473**	-0.680**	-0.894**	-0.587**	-0.558**
Lipid peroxidase						1	-0.539**	-0.730**	-0.976**	-0.602**	-0.564**
Catalase							1	-0.340**	-0.526**	-0.428**	-0.417**
Mechanical strength								1	0.754**	0.620**	0.601**
Lignin									1	0.605**	0.568**
Initial germ. test										1	0.972**
AAT											1

*, ** Significant at 5% and 1% level of significance, respectively

Conclusion

The correlation analysis of the cross DS-228 × MACS-450 highlights several key relationships among seed traits. Seed coat proportion was positively correlated with accelerated aging test (AAT), initial germination, lignin content, seed mechanical strength, catalase, and seed density, while negatively correlated with seed coat permeability, peroxidase, lipid peroxidase, and ascorbate peroxidase. Seed coat permeability showed positive correlations with peroxidase, lipid peroxidase, and ascorbate peroxidase, but negative correlations with AAT, initial germination, lignin content, seed mechanical strength, and catalase. Seed density positively correlated with AAT, initial germination, lignin content, seed mechanical strength, and catalase, but negatively with peroxidase, lipid peroxidase, and ascorbate peroxidase. Additionally, peroxidase, lipid peroxidase, and

ascorbate peroxidase were all positively correlated with each other, but negatively correlated with several other traits. These correlations underscore the complex interplay between seed traits and suggest that improving seed quality may involve targeting multiple physiological and biochemical parameters.

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