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Effect of polymer seed coating on Phenophasic developments, Morpho- physiological and yield attributes of soybean

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Abstract
The present study was conducted at the Research Farm Adhartal, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P.) during *Kharif* season of 2016-17. Research experiment was laid out in a Randomized block design with five replications and four treatments i.e T0 No treatment or (Water + Thiram), T1- Polymer seed coating (Disco AG SP Red L-200) + Thiram + Carboxine, T2- Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat, T3- Polymer seed coating (Disco AG SP Red L-200) + Thiram + Mycorhiza comprised of soybean genotype JS JS 20-29. Five plants were randomly selected from each treatment and replications for Phenophasic developments, Morpho- physiological and yield attributes of soybean. Improvement in structural yield attributing components resulted in maximum realization of productivity potential of soybean treatments. The significant variation was noted among soybean treatments with respect to their components of yield with biological and seed yield. Plant height, no. of branches per plant, no. of pods per plant, no. of seeds per plant, pod length, pod width, seed index, biological yield, seed yield and harvest index was noted maximum in treatment T2- Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat.

Keywords: Soybean, phenophasic developments, morpho- physiological traits, yield attributes, harvest index, polymer seed coating

Introduction
Soybean is native of China. It has emerged as one of the important commercial crops in many countries. Soybean is also known as the “Golden bean” or “Miracle crop” because of its multiple uses. Soybean is a crop of multiple qualities as it is both a pulse and oilseed crop. In India, It contributes around 25% of total edible oil pool of the country. The main soybean producing states in India are Madhya Pradesh (56 percent), Maharashtra (37 percent), and Rajasthan (11 percent). All India soybean production is 86.426 Lakh MT and average yield is 784 kg/ha on 110.656 lac ha. Madhya Pradesh is known as the “Soybean State” of India, comprising 55% of the total national area of soybean cultivation. Madhya Pradesh is the soybean bowl of India, contributing 65-70 per cent of country’s soybean production, followed by Maharashtra, Rajasthan and Karnataka which is much below the average national and world productivity.
Seed coating technology has developed rapidly during the past two decades and provided an economical approach to seed enhancement. a advantage of seed coating is that the seed enhancement material (Fungicide and insecticide) in placed directly on the seed without obscuring the seed shape (Kumar, 2007) [10]. The polymer keeps the seed intact, as it acts binding material and corers the miner cracks and aberration on the seed coat and blocking the fungal invasion as well act as a physical barrier which reduces leaching of inhibiters from seed coverings and restrict oxygen movement and thus reducing the respiration of embryo there by reducing the ageing effect on seed. The polymer also prevents moisture content fluctuations during storage (West *et al.*1985) [15]. Seed coating with natural or synthetic polymers have gained rapid acceptance by the seed industry as a much safer coating material. The stability of poly coated seeds has also to be investigated in order to determine the viability of seeds for long term. Polycoated seeds can be stored for long term, if adequate storage condition are provided (Giang and Gowda, 2007) [6].
The productivity efficiency of any cultivar depends on its functional yield attributes which provide a basis for evolving better plant ideotype through breeding with higher yield potential and its maximum realization in a given set of environmental conditions. Higher seed yield of any crop can be achieved only through proper combinations of a cultivar, environment and agronomic practices. The basic component of living cells is proteins, with building block material, amino acids.

Proteins are formed by sequence of amino acids. The requirement of amino acids in essential quantities is well known as a means to increase yield and overall quality of crops. The application of amino acids for foliar use is based on its requirement by plants in general and at critical stages of growth in particular. Plants absorb amino acids through stomata and are proportionate to environment temperature. Keeping in view of the above facts the main objectives of this study were (i) To investigate Phenophasic developments and (ii) Morpho- physiological and yield attributes of soybean

Materials and Methods

The present study was conducted at the Research Farm Adhartal, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P.) during *Kharif* season of 2016-17. Research experiment was laid out in a Randomized block design with five replications and four treatments i.e T0 No treatment or (Water + Thiram), T1- Polymer seed coating (Disco AG SP Red L-200) + Thiram + Carboxine, T2- Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat, T3- Polymer seed coating (Disco AG SP Red L-200) + Thiram + Mycorhiza comprised of soybean genotype JS JS 20-29. Five plants were randomly selected from each treatment and replications for Phenological and Physiological Parameters

Phenophasic Developments

a) **Days to flower initiation:** A day to flower initiation was taken from the date of sowing to date of first flower seen in the field plants before 50% flowering.
b) **Days to 50% flowering:** Days to 50% flowering was taken from the date of sowing to the date of 50% plants have at least one flower.
c) **Days to Completion of flowering:** Days to completion of flowering was taken from the date of sowing to the date of all plants have at least one flower.
d) **Days to pod formation:** A day to pod formation was taken from the date of sowing to the first pod visible on plant.
e) **Days to physiological maturity:** This was recorded from the date of sowing to physiological maturity.
f) **Days to maturity:** Days to maturity was taken from the date of sowing to the date when 95% pods turn yellow or brown.

Morpho-Physiological, Structural yield and yield attributes

a) **Plant height (cm):** Plant height was recorded at harvest from the soil surface to the tip of uppermost node.
b) **Number of branches/plants:** The number of branches/plants was calculated by tagging five plants at maturity.
c) **Number of pods/plants:** The number of pods/plants was calculated by tagging five plants at maturity.
d) **Number of seeds/pods:** The number of seeds/pods was recorded from five tagged plants at maturity.
e) **Pod length (mm):** Length of the pod was measured from the base to the tip of the pod and expressed in centimeters (cm).
f) **Pod width (mm):** The pod width was recorded by using the scale from top, middle and bottom of pod and average was recorded as the pod width.
g) **Pod width (mm):** The pod width was recorded by using the scale from top, middle and bottom of pod and average was recorded as the pod width
h) **Seed Index (100 seed weight) (g):** 100 seed were taken from the produce of each plot and their weight was recorded by electronic balance.
i) **Biological yield (g/plant and kg/ha):** Biological yield is the total yield of crop including economic yield and the Stover yield. The biological yield per plant and kg/ha was recorded after harvesting.
j) **Harvest index:** Harvest index is the ratio of economic yield to the total biological yield expressed in percentage. It represents the efficiency of photosynthates translocation to economic parts (Synder and Carlson, 1984) [14].

Results and Discussion

Phenophasic Developments: The treatments varied significantly among themselves with respect to requirements of days to shift various phenol phases during crop growth period (Table no. 01)

a) **Days to flower initiation:** The results showed that no treatment or (Water + Thiram) (T0)(36) attained significantly maximum days for flower initiation followed by Polymer seed coating (Disco AG SP Red L-200) + Thiram + Carboxine (T1) (35.8) and Polymer seed coating (Disco AG SP Red L-200) + Thiram + Mycorhiza (T3) (36.4) over remaining Treatment. On the other hand Treatment Polymer seed coating (Disco AG SP Red L-20). These results are consistent with the study of Adhikari and Pandey (1982) [1] they observed that Days to flower initiation plays an important role in the productivity of crops and was found to be positively correlated with seed yield.
b) **Days to 50% flowering:** The results revealed that No treatment or (Water + Thiram) (T0) (38.6) required significantly maximum days for attainment of 50% flowering among themselves. Treatment Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat (T2) (37), required significantly lesser time for 50% flowering. The longer duration of reproductive period was found to be associated with the higher economic productivity in several investigations. Pattern of flower production, pod retention, number of flowers produced and percentage of flowers and pods abscised varied with cultivars **(**Zaiter and Barakat, 1995)
c) **Days to Completion of flowering:** The No treatment or (Water + Thiram) (T0) (41.3) took significant maximum period for Completion of flowering. While Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat(T2) (4o) noted minimum days for the completion of flowering
d) **Days to pod formation:** No treatment or (Water + Thiram) (T0) (52.6), significantly maximum days requirement for pod formation. However, noted significantly minimum days to pod formation was noted in Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat (T2) (49.75). In soybean their pods developed slowly for the first few days following fertilization. Rapid elongation began about the fifth day and full length is attained by the fifteenth to seventeenth day. Seeds within the pods did not grow at the same rate for the first 10-15 days after fertilization, the apical seed developed most rapidly in the second phase, just after full elongation of the pod the basal seed showed more rapid growth (Kato and Naito 1954) [9]. Sahu *et al*, 2018 [3] also reported similar findings

e) **Days to physiological maturity:** Results showed that Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat (T2) (72.0) attained significantly early physiological maturity.WhileNo treatment or (Water + Thiram) (T0)(73.8)required significantly maximum days to attain physiological maturity. The physiological maturity is the stage at which the seeds gain their maximum dry weight (Harrington, 1972) [72].

f) **Days to maturity:** Results showed that No treatment or (Water + Thiram) (T0) (81.6) showed significantly early field maturity. Treatment Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat(T2) (83.4) noted significantly maximum time was required for field maturity.

Table 1: Variation in Phenophasic developments in soybean Treatment under polymer seed coating technology

Treatments	Phenophasic developments in soybean Treatments						
	Days to flower initiation	Days to 50% flowering	Days to completion of flowering	Days to pod formation	Days to seed formation	Days to physiological maturity	Days to maturity
No treatment or (Water + Thiram) (T0)	36.6	38.6	41.3	52.6	61.4	73.8	83.4
Polymer seed coating (Disco AG SP Red L-200) + Thiram + Carboxine (T1)	35.8	37.8	40.4	51	60.8	72.8	82.6
Polymer seed coating (Disco AG SP Red L-200) + Thiram + Genius coat (T2)	35.2	37	40	50.8	60.2	72	81.6
Polymer seed coating (Disco AG SP Red L-200) + Thiram + Mycorhiza (T3)	36.4	38.4	41.2	52.4	61.0	73	82.8
MEAN	36	37.95	40.7	51.7	60.85	72.9	82.6
SEM±	0.242	0.224	0.292	0.316	0.158	0.297	0.356
C.D 5%	0.752	0.697	0.908	0.985	0.493	0.926	1.109

Morpho-Physiological, Structural yield and yield attributes: These are presented in table no.02

a) **Plant height (cm):** Plant height was maximum for T2 (56.36 cm) and minimum was for T0 (52.42) with average 54.66 cm. Sharma and Sharma (1993) [13] found that a wide variation in plant height (57.2 to 83.9 cm) and number of branches (3 to 4.2) among soybean genotypes.

b) **Number of branches/plants:** The number of branches/plants was maximum for T2 (3.88) and minimum was for T0 (3.88) with average 4.165. Similarl finding were also reported by Jain *et al*. (2002) [8].

c) **Number of pods/plants:** The number of pods/plants was maximum for T2 (75.4) and minimum was for T0 (69.2) with average 72.96.

d) **Number of seeds/pods:** The number of seeds/pods was maximum for T2 (2.94) and minimum was for T0 (2.132) with average 2.414. Onemi (2003) [11] reported that the plant yield reported positive and significant correlation with number of branches and number of seeds per pod. Sahu *et al*, 2019 [4] also reported similar findings

e) **Pod length (mm):** Length of the pod was maximum for T2 (38.16) and minimum was for T0 (31.52) with average 34.24 mm.

f) **Pod width (mm):** The pod width was maximum for T2 (5.32) and minimum was for T0 (4.44) with average 4.775mm.

g) **Seed Index (100 seed weight) (g):** 100 seed weight was maximum for T2 (10.20) and minimum was for T0 (7.17) with average 8.727 gm. The results also corroborate with the findings of Chikkanna *et al.* (2000) [5].

h) **Biological yield (g/plant and kg/ha):** Biological yield was maximum for T2 (4576) and minimum was for T0 (3294.7) with average 3843.4 kg/ha. Similar result were also reported by Ramgiry and Raha (1997) [12] his research were Indicated that seed yield per plant showed positive correlation with biological yield per plant. At genotypic and phenotypic levels, biological yield per plant had the greatest positive relationship with seed yield and appeared to be the major yield contributing characters in soybean.

i) **Harvest index (%):** Harvest index was maximum for T2 (21.63) and minimum was for T0 (21.57) with average 21.80%.

Table 2: Variation in Morpho-Physiological, Structural yield and yield attributes in soybean as influenced by the polymer seed coating.

Treatments	Plant height (cm)	No of Branches /plant	No of pods/ plant	No. of seeds/ pod	Pods/ length (mm)	Pod width (mm)	Seed index (gm)	Biological yield		Harvest index (%)	Seed Yield	
								g/plant	Kg/ha		g/plant	Kg/hac
T0	52.46	3.88	69.2	2.132	31.52	4.44	7.14	12.48	3,294.72	21.578	2.7	712.8
T1	54.364	3.96	71.84	2.292	32.84	4.62	8.27	13.12	3,568.64	22.513	2.88	783.36
T2	56.36	4.86	75.4	2.940	38.16	5.32	10.2	16.00	4,576.00	21.631	3.42	978.12
T3	55.40	3.96	72.96	2.292	34.44	4.72	9.3 0	14.68	3,934.24	21.500	3.04	814.72
Mean	54.64	4.16	72.35	2.414	34.24	4.77	8.72	14.07	3843.4 0	21.805	3.01	822.25
SE(m) ±	0.419	0.164	0.665	0.085	1.044	0.1	0.653	0.813	220.721	0.215	0.143	38.766
C.D. 5%	1.306	0.51	2.071	0.264	3.253	0.312	2.034	2.533	687.642	0.671	0.447	120.773

Knowing how plants function in a natural environment, their potential for harvest and how they might respond to potentially stressed environmental change is essential to learning how to manage world resources in a time of burgeoning world population. The physiology of photosynthesis – light capture, energy conversion and partitioning of carbon are at the root of productivity. The term productivity refers to an increase in biomass – the dry matter content of an organ, organism or population. Carbon economy is the term used to describe balance between carbon acquisition and its utilization. Respiration is the principle counter balance to photosynthesis, respiration consumes assimilated carbon in order to obtain the energy required to increase and maintain biomass. Respiratory losses of carbon constitute one of the most significant intrinsic limitations on plant productivity.

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