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Evaluation of Soybean [*Glycine max* (L.) Merill] for Phenology, Physiology, Growth, Productivity and Quality under Various Herbicidal Treatments

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A B S T R A C T

A research experiment was conducted at the Research Farm, Department of Agronomy, JNKVV, Jabalpur (M.P.) during *Kharif* season of 2018 which was laid out in a Completely Randomized Block design with three replications. Seven treatments comprised of combinations as well as single application of herbicides T_1 (Propaquizafop @ 50 gha^{-1}), T_2 (Propaquizafop @ 60 gha^{-1}), T_3 (Propaquizafop @ 75 gha^{-1}), T_4 (Propaquizafop + Imazethapyr @ (75 + 50) gha^{-1}), T_5 (Quizalofop @ 70 gha^{-1}), T_6 (Hand weeding @ 20 and 40 DAS) and T_7 (Weedy Check). The results revealed that treatment T_2 had the longest (56.75 days) span of reproductive phase, whereas the treatment T_4 had the shortest (55.25 days) span. T_2 had the longest span of seed filling period (28.92 days). On the other hand, treatments T_4 and T_5 (27.33 days) indicated lowest time for seed filling duration. T_6 recorded maximum biological yield (16.44 $gplant^{-1}$ and 5479 $kgha^{-1}$) which ultimately reflected in its maximum seed yield (5.74 $gplant^{-1}$ and 1912 $kgha^{-1}$). The maximum fat (21.16%), carbohydrates (18.76%) and ash contents were registered in treatment T_6 (5.64%), whereas crude fiber (8.34%) and proteins (40.12%) were registered in T_4.

Introduction

Soybean [*Glycine max* (L.) Merill] is known as the *"GOLDEN BEAN"* of the 20th Century. It accounts approximately 50% of total production of oilseed crops in the world. It has emerged as one of the important commercial crops in many countries. Soybean is also known as the "Miracle Crop" because of its multiple uses and qualities as it has been used as pulse as well as oilseed crop. It has great potential as an exceptionally nutritive and very rich protein food. Soybean contains 35-40% protein, 19% oil, 35% carbohydrate (17% of which is a dietary fibre), 5% minerals and several other components including vitamins (Liu, 1997). Owing to its amino acids composition, the protein of soybean is called a complete protein. In India, soybean cultivation is done in 10.56 million hectares with the annual production of 11.39 million metric tons and average productivity of 1078.6 kg $hectare^{-1}$ (MOA & FW, 2018). Among different states of India, Madhya

Pradesh occupies the first position in area i.e. 54.09 lakh hectares and production of 59.17 lakh million tons with average productivity of 1094 kg ha^{-1} (SOPA, 2018). In M.P., farmers apply high seed rate and narrow spacing of plant and rows to avoid risk of less plant population. Farmers in field apply more than 25 per cent more seed than needed. This is because of for poor equipment or lack of calibration. Some of it is just habit, but some producer feels that the high seeding rates are needed for better weed control. The low productivity of the crop in the state is due to several constraints, one of the major constraints in soybean production is crop-weed competition (Vollmann *et al.,* 2010); being a rainy season crop, as it is heavily infested with grasses, sedges and broadleaved weeds. The weed control practices have been exercised for the long time. Recently developed herbicides response to the weeds, crop physiological traits, productivity and quality aspects in soybean needs to be ascertained. Keeping in view of the above facts, the present investigations are undertaken

Materials and Methods

An experiment was conducted to evaluate the effect of various herbicidal treatments on phenophasic development and productivity with biochemical aspects in soybean during *Kharif* season of the year 2018 at the Research Farm of Department of Agronomy, JNKVV, Jabalpur (M.P.). Estimation of biochemical constituent was done in the laboratory of the Department of Plant Physiology, JNKVV, Jabalpur. The seven weed control treatments comprising of T_1 (Propaquizafop @ 50 gha^{-1}), T_2 (Propaquizafop @ 60 gha^{-1}), T_3 (Propaquizafop @ 75 gha^{-1}), T_4 (Propaquizafop + Imazethapyr @ (75 + 50) gha^{-1}), T_5 (Quizalofop @ 70 gha^{-1}), T_6 (Hand weeding @ 20 and 40DAS) and T_7 (Weedy Check) were laid out in Completely Randomized Block Design with three replications. Seeds and soybean (JS 20-29) were sown in the field adopting recommended cultural practices. The phenological observations were noted from three selected and tagged plants throughout the growth period through daily visual observations.

The ash content in the seed sample was estimated according to AOAC (1980). Total carbohydrates in the samples were estimated by the method as described by Sadasivam and Manickam, 1992. The nitrogen content was estimated by micro Kjeldhal method (A.O.A.C., 1980) and the fat content in the sample was estimated by pelican equipment socs plus based on principle of Soxhlet's extraction method as described in AOAC (1980).The seed yield g $plant^{-1}$ and kg ha^{-1} was recorded after threshing, cleaning and drying the seeds. It is also known as economical yield. Biological yield is the total yield of crop including economic yield and the straw yield. The biological yield per plant was recorded after harvesting.

Results and Discussion

Phenophases

Days to flower initiation

The investigations (Table 1) indicated that treatments T_3, T_5 and T_6 (35.00 days) acquired minimum days to attain flower initiation stage which is a beneficial trait for prolonging the reproductive phase. On the other hand, treatment T_1 (36.00 days) took the maximum time to record flower initiation. It is worthwhile to indicate that the treatments had not too much variation for this trait. The seed yield was positively and directly influenced by days of flower initiation (Kumar *et al.*, 2012).

Table.1 Phenophases in soybean during reproductive growth period under different herbicidal treatments

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
T1 = Propaquizafop @ 50 gha^{-1}	36.00	39.50	46.75	55.25	64.25	76.25	92.42
T2 = Propaquizafop @ 60 gha^{-1}	35.67	37.67	48.75	54.25	63.50	76.75	92.42
T3 = Propaquizafop @ 75 gha^{-1}	35.00	39.00	47.75	54.25	64.75	76.75	91.42
T4 = Propaquizafop + Imazethapyr @ (75+50) gha^{-1}	35.33	39.00	48.25	55.25	63.25	78.75	90.58
T5 = Quizalofop @ 70 gha^{-1}	35.00	38.00	47.75	54.25	64.25	76.25	91.58
T6 = Hand Weeding @ 20 and 40 DAS	35.00	38.00	48.50	55.75	62.50	75.75	90.58
T7= Weedy Check	35.00	39.00	46.25	52.25	64.50	75.25	91.08
SEm±	0.22	0.34	0.47	0.46	0.51	0.47	0.39
CD 5%	0.68	1.06	1.45	1.41	1.57	1.43	1.19

Table.2 Productivity in soybean under various herbicidal treatments with biochemical constraints

Treatments	Ash (%)	Crude fiber (%)	Carbohydrate (%)	Protein (%)	Fat (%)	Seed yield		Biological yield	
						g plant^{-1}	Kgha^{-1}	gplant^{-1}	Kg ha^{-1}
T1	5.24	6.37	17.56	38.06	18.23	3.40	1132	11.15	3716
T2	4.88	6.14	17.81	38.43	19.28	4.92	1640	15.71	5237
T3	5.23	8.12	18.39	38.36	19.45	5.09	1698	15.69	5231
T4	5.12	8.34	18.48	40.12	20.57	5.50	1832	16.02	5340
T5	5.26	6.52	17.77	38.63	18.88	4.30	1434	12.99	4329
T6	5.64	7.65	18.76	39.3	21.16	5.74	1912	16.44	5479
T7	4.89	6.43	16.44	37.09	17.35	2.20	732	8.38	2792
SEm±	0.07	0.23	0.34	0.45	0.26	0.23	49.66	0.50	109.54
CD 5%	0.23	0.69	1.05	1.37	0.81	0.71	153.0	1.56	337.54

Days to 50% flowering

The results showed (Table 1) that treatments T_3, T_4 and T_7 (39.00) required maximum time for completion of 50% flowering. On the other hand, lowest time was recorded in T_2 (37.67). This suggested that the treatments didn't indicate a similar pattern in respect of days to flower initiation and completion of 50% flowering. The pattern of flower production, pod retention, number of flowers produced and percentage of flowers and pods abscised varied with cultivars (Zaiter and Barakat, 1995).

Days to completion of flowering

The investigations indicated (Table 1) that treatment T_7 (46.25 days) took minimum time for completion of flowering, whereas treatment T_2 (48.75 days) required maximum time for completion of flowering.

The pattern from flower initiation to completion of flowering responded variably in different treatments. Flowering was started at 45 to 50 DAS, depending on genotypes (Khan and Khalil, 2010).

Days to pod formation

Treatment T_6 (55.75 days) registered (Table 1) maximum time for formation of pods. On the other hand, T_7 (52.25 days) needed minimum time to attain this stage. Earlier investigations showed that early pod formation resulted in high productivity which contradicts the result of present investigations.

The weed competition is one of the most important causes of yield loss (30 to 80%) in *kharif* soybean and modification in source sink balance could increase assimilates distribution towards the pods (Yaduraju, 2016).

Days to seed formation

The present study showed (Table 1) that treatment T_6 (62.50 days) had the earliest seed formation which is a beneficial trait for enhancing economic productivity in crop plants. However, treatment T_3 (64.75 days) had delayed seed formation. Normally early seed formation is positively correlated with the seed productivity provided the seed filling rate is at optimum speed.

Days to physiological maturity

In the present study (Table 1), treatment T_7 (75.23 days) recorded the minimum and T_4 (78.75 days) maximum time to achieve this stage. The real physiological maturity may be advantageous if the seeds are harvested at that particular stage (Gontia *et al.,* 1995).

Days to maturity

The study showed (Table 1) that treatments T_4 and T_6 (90.58 days) attained the maturity earliest which has the advantage of avoiding shattering which sometimes takes place when the crop is harvested at the later stages. Treatment T_1 and T_2 (92.42 days) took maximum time for reaching the maturity. The seed yield plant^{-1} was found to be significantly and positively correlated with days to maturity (Kumar *et al.,* 2004). Among morphological traits under water stress conditions, the days to maturity showed the maximum reduction (94%) (Shadakshari *et al.,* 2014).

Seed yield (g plant^{-1} and kg ha^{-1})

The results indicated (Table 2) that all the treatments significantly increased seed yield in soybean. The results were in accordance with the findings of Deore *et al.,* (2007), Pradhan *et al.,* (2010) and Tuti and Das (2011). The improvement in the yield and

economic parameters were obtained under different weed management practices in soybean (Raskar and Bhoi, 2002).

Biological yield (g plant^{-1} and kg ha^{-1})

The present study (Table 2) indicated that the treatments T_6 (16.44 gplant^{-1} and 5479 kg ha^{-1}) and T_7 (16.02 gplant^{-1} and 2792 kgha^{-1}) recorded higher magnitudes for biological yield. It is further mentioned that higher biological yield is not always indicative of higher economic yield as it depends on allocation of photoas similates into the vegetative or reproductive parts of the plant.

Under herbicidal treatments the highest seed yield (24.46 qha^{-1}) and straw yield of soybean were also recorded in Imazethapyr @ 0.100 kg a.i.ha^{-1} + Quizalofop ethyl @ 0.075 kg a.i. ha^{-1} as PoE (Prachand *et al.*, 2014).

Biochemical constituents

Ash (%)

The present study (Table 2) indicated that treatment T_6 (6.54%) recorded the highest and T_2 (4.88%) lowest ash contents, respectively. In ten vegetable soybean genotypes along with the control the ash content was ranged from 1.49-1.74 % (Salmani *et al.*, 2012).

Crude fiber (%)

In ten vegetable soybean genotypes along with the control the fiber content was ranged from 1.89-2.69 %. On the other hand, in the present investigations (Table 2), the crude fiber was found to be in the range of 8.34% in T_4 and 6.4% in T_2, respectively.

Carbohydrate (%)

The present study (Table 2) indicated that the treatments T_6 (18.76%) and T_4 (18.48%) recorded the higher magnitudes which is beneficial trait for all the aspects. The carbohydrates provide the energy for growth and various functions in the plant. In ten vegetable soybean genotypes along with the control the carbohydrate content was ranged from 5.88-7.93 % (Salmani *et al.*, 2012).

Protein (%)

The protein is very important for maintaining structural integrity of plant cells and also acts as energy source under starvation. The present study (Table 2) indicated that treatments T_4 (40.12%) and T_6 (39.3%) had the higher magnitudes for protein contents, whereas treatment T_7 recorded the minimum (37.09%).However, Salmani *et al.*, (2012) reported 12.32 - 14.96 % protein content in ten vegetable soybean genotypes. The dry matter and yield components had strong negative association with protein content. Variety Awassa-95 (45%) recorded significantly higher protein contents than variety Belessa-95 (40%) (Pal *et al.*, 2012).

Fat (%)

The present investigations showed (Table 2) that treatment T_7 had the maximum (21.16) fat %, whereas the lowest (17.35%) was found in T_7. The promising varieties of soybean have been found to contain the oil in the range of 19-24 percent oil concentrates increase both herbicidal effectiveness and the possibility of soybean injury (Ariunaa *et al.*, 2016). The yield obtained by early planting was positively correlated with the oil contents (Naoki *et al.*, 2016).

In conclusion the studies pertaining phenophases indicated that treatment T_2 had the longest (56.75 days) span of reproductive phase, whereas the treatment T_4 had the shortest (55.25 days) phase of reproductive phase. T_2 had the longest span of seed filling

period (28.92 days). On the other hand, treatments T_4 and T_5 (27.33 days) indicated lowest time for seed filling duration. Treatment T_6 (Hand Weeding @ 20 and 40 DAS) out yielded maximum seed yield (5.74 g $plant^{-1}$ and 1912 kg ha^{-1}) and biological yield (16.44 $gplant^{-1}$ and 5479 $kgha^{-1}$).Treatment T_4 [Propaquizafop + Imazethapyr @ (75 + 50) gha^{-1}] was adjudged the second in yield performance (5.50 $gplant^{-1}$ and 1832 $kgha^{-1}$) and biological yield (16.02 $gplant^{-1}$ and 5340 $kgha^{-1}$). Treatment T_7 indicated the lowest yield (2.20 $gplant^{-1}$ and 732 $kgha^{-1}$) owing to poor performance of all yield components. The maximum fat (21.16%), carbohydrates (18.76%) and ash contents were registered in treatment T_6 (5.64 %), whereas crude fiber (8.34 %) and proteins (40.12 %) were in T_4.

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References

AOAC.Official methods of analysis, 13th ed. Association of official Analytical chemists Washington DC, 1980, 376-384.

Ariunaa O, Otgonsuren M and Bayarsukh N. Effect of chemical weed control of soybean (*Glycine max* L.) field in Mongolia. International Journal Advanced Research Biological Sciences 2016; 3(1): 192-198.

Deore NR, Solanke AV, Shete BT, Tambe AD and Nikam AS. Chemical Weed Control in Soybean. Annals of Plant Physiology. 2007; 21(1): 75-77

Gontia, A.S., Nigam, P.K., Sonakia, V.K. and Dwivedi, S.K. Identification of morphological indices of physiological maturity in soybean genotypes. Indian Journal of Agricultural Sciences 1995; 65 (6): 414 -18.

Khan A and Khalil A. Effect of leaf area on dry matter production in aerated mungbean seed.International Journal Plant Physiology and Biochemistry 2010. 2: 52-61.

Kumar R, Ravikant K and Ojha CB.Character association analysis in mung bean. Legume Research 2004; 27(1):32-36.

Liu KS. Chemistry and Nutritional Value of Soybean Components In Soybeans. Chemistry, Technology and Utilization, Liu, K.S. (Ed.).Chapman and Hall, New York, 1997, USA 25-113.

MOA & FW (Ministry of Agriculture and Farmers Welfare).2018.Directorate of Economics & Statistics.

Naoki M, Koichiro F and Shinori T. Effects of early planting and cultivars on the yield and agronomic traits of soybeans grown in south-western Japan Plant Production Science 2016; 39-43.

Pal Daniel, Markos UR and Uragie Elias. Dry matter partitioning, nodulation and seed traits of medium and late maturing soybean varieties as affected by planting pattern and plant density. Journal of Agricultural Science and Technology 2012; 2(1):142-150.

Prachand S, Kalhapure A and Kubde K. Weed management in soybean with pre and post-emergence herbicides *Indian Journal of Weed Science* 2014; 47(2): 163–165.

Pradhan SS, Kolhe VS and Singh V. Studies of weed control efficiency by application of post-emergence herbicides in soybean in Chhattisgarh plain. Indian Journal of Weed Science 2010; 42(1&2): 101-103.

Raskar BS and Bhoi PG. Bio-efficacy and

phytotoxicity of pursuit plus herbicides against weeds in soybean (Glycine max L.). Indian Journal of Weed herbicides against Science 2002; 34(1&2): 50-52.

Sadasivam S and Manickam A. Biochemical methods for agricultural sciences 1992; 12-13.

Salmani Z, Vijayalakhsmi D and TY. Screening of selected vegetable soybean genotypes for nutrient and anti-nutrient factors. Journal of Dairying, Foods and H.S 2012; 31(2):142-145.

Shadakshari TV, Yathish KR, Kalaimagal T, Gireesh C, Gangadhar K and Jaggal S. Morphological response of soybean under water stress during pod development stage. Legume Research 2014; 37(1): 37–46.

SOPA.The Soybean Processors Association of India 2018.Tuti MDI and Das TK. Sequential application of metribuzin on weed control, growth and yield of soybean (*Glycine max) Indian Journal of Agronomy* 2011; 56 (1): 57-61.

Vollmann J, Wagentristl H and Hartl W. The effects of simulated weed pressure on early maturing Soybean. European Journal of Agronomy 2010; 32: 243-48.

Yaduraju A, Malik RK, Punia SS. Studies on carry-over effects of herbicides applied in wheat on the succeeding crop in rotation. Indian Journal of WeedScience2016; 36(1&2): 15-18.

Zaiter HZ and Barakat SA. Flower and pod abortion in chickpea as affected by sowing date and cultivar. Canadian Journal of Plant Science 1995; 75: 321-327.

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