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Performance of Some Soybean Genotypes (Glycine max L.) to Germination and Seedling Characters as Affected by Planting Dates and Phosphorus Fertilization

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Abstract— *To investigate the performance of some sunflower genotypes to phosphorus fertilizer rates and planting dates to germination characters and seedling parameters. A laboratory experiment accompanied in seed lab during April and May 2017.The experiments included six sowing dates at 1th May, 15th May and 31th May, three soybean cultivars namely Crawford, Giza 22 and Giza 111 and three rates of phosphorus fertilizer viz. 0, 37.2 and 74.4 kg P_2O_5/ha.The tallest shoot, great percentages of germination, the lowermostpercentagesof dead seedand the highestcoefficient of velocitypercentage from sown on mid-May. In addition, the lowest days of germination time was produced from sown on first May. Whereas, the tallest root, the highest weight of fresh shoot and root as well as shoot dry weight from sown on end-May.The results clearly revealed that the highest percentage of germination, soot length and root length obtained from sown cv. Giza 111. The uppermostenergy of germination, shoot and root dry weight were recorded from sown Giza 22 cultivar. In addition, sown Crawford cultivar produced the highestdead seedpercentage and the lowest mean germination time.The results indicated that the lowest mean germination time and maximum percentage of coefficient of velocity, tallest shoot and root, weight of fresh shoot, shoot and dry root were obtained fromfertilizationof phosphate at the rate of31 kgP_2O_5/fed. It summarized that seed Giza 111 cultivar recorded the best in seed viability when sown on first May and fertilized with phosphorus fertilizer at the rate of 74.4 kg P_2O_5/ha.*

Keywords— Soybean cultivars, planting dates, phosphorus fertilization rates, seed germination characters and seedling parameters.

I. INTRODUCTION

Soybean (Glycine max (L.) Merrl) is considered the most important oil crop in Egypt. To overcome the shortage of edible oil in Egypt, it could be achieved sown soybean at proper agronomic management, such as, sowing times of different soybean cultivars and phosphorus fertilizer rates and their effect on seed quality. The increase of seed production may attributed to agriculture management that could potentially improve seed viability.The JS-335 variety recorded the highest increase in germination percentage and seedling vigour index. Germination percentage, seedling vigour index and seedling dry weight decreased progressively as sowing delayed **(Vidyapeeth, 2002**). Sown at different dates affect seed productivity andcreatinga goodseed quality **(Rahman et al., 2005).** Sowing date is an important factor regulating soybean seed quality. G-2 cultivar had higher percentages of germination and seed vigour than cultivar PB-1 or BS-5 genotypes. The highest germination percentage and good vigour produced from all the cultivars on November and December sown.Whilst, sown in September increased germination percentage and seedling vigour during Kharif II. Sown during November to December in Rabi season and August to September in Kharif-II season produced the highest germination percentage**(Rahman et al., 2013).**The Giza 21 varietytopped other varieties in the seedling vigor index; however, Giza 35 varietyproduced the latest germination time **(Kandil et al., 2015).**

A significant variation in the percentage of germination and vigor index due to different sowing dates. Sown on 2nd December maximized the percentage of germination and vigor index that recordeda good quality soybean seed (**Kundu et al., 2016)**.Fertilization with K, Zn, and P enhanced seed viability and seedling vigor (**Sawan et al., 2011).**Extremein P and K fertilization rates can result in lower seed viability and vigor **(Krueger et al., 2013).**Therefore, the goal of this research is aimed to investigate soybean seed cultivars viability as influenced by sowing date and phosphorus fertilization rates.

II. MATERIALS AND METHODS

2.1. Research time and site:

The laboratory experiment intended to study the effect of three sowing dates at 1th May, 15th May and 31th Mayfor three soybean cultivars (Crawford, Giza 22, Giza 111) under and three phosphorus fertilizer rates (0, 37.2 and 74.4 kg P_2O_5/ha)to germination and seedling parameters.Afactorial experiment in RCBD with four

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replicationwas used. The experiment includes three factors, the first three sowing date at 29th April, 14th May and 30th May The second factor included three soybean cultivars*i.e.*Crawford, Giza 22, Giza 111) from ARC, Ministry of agriculture, Egypt. The third cultivar includesthe three phosphorus fertilizer rates (0, 37.2 and 74.4 kg P_2O_5/ha. Twenty-five seeds of uniform size in each treatment for each cultivar allowed germinating on a filter paper in 9 cm diameter Petri dishes. Seeds were germinate in a germination chamber in 20-25ºC.Thus, the whole experiment comprised 108 Petri dishes. Each filter paper moistened with a distilled water according to **ISTA Rules, 2016**.

2.2. Studied Characters:

Soybean seed of both seasons subjected for determination of germination characters and seedling parameters in the laboratory experiment. Germination characterswere estimated as follows:

1- The final germination percentage was determined after 8 days from sowing as equation described by **(Ellis and Roberts, 1981& Ruan *et al*. 2002).**

$$FGP = \frac{\text{Number of germinated seeds}}{\text{Total Number of seed tested}} \times 100$$

2-The Germination Index was calculated according to **Karim *et al*. (1992)** equation**.**

$$GI = \frac{\text{\% Germination in each treatment}}{\text{\% Germination in the control}} \times 100$$

3. The energy of germination was recorded on the fourth day according to **Ruan *et al*., (2002)**equation**.**

$$EG = \frac{\text{Number of germinated seeds after four days}}{\text{Number of seed tested}} \times 100$$

4-Average of coefficient of velocity (CV) was calculated using the following formula as described **by Scott et al., 1984:**

5-The mean germination time (MGT): It was determined according to the equation of **Ellis and Roberts (1981)**:

$$MGT = \sum dn \div \sum n$$

6-Percentage of dead seed = Number of dead seed /total number of seeds

7-Shoot length (cm)of five seedlings from the seed to the tip of the leaf blade was measured.

8-Root length (cm)of five seedlings from the seed to the tip of the root was measured.

9-Weight of the fresh shoot (g) of five seedling shoots was weighted.

10-Weight of fresh root (g)of five seedling roots was weighted.

11-Weight of dry shoot (mg)of five seedling shoots was weighted after oven dryingat 75 º C for 48 h.

12-Root dry weight (mg)of five seedling shoots was weighted after oven dryingat 75 º C for 48 h.

2.3. Experimental analysis:

Collected data, statistical analysis of variance technique using the MSTAT–C statistical package programmed as described by a procedure of Gomez and Gomez (1991). For comparisons between treatment means, the lest significant differences test (LSD) for 5 and 1 % level of probability was used according to Snedecor and Cochran (1980).

III. RESULTS AND DISCUSSIONS

3.1. Effect of sowing dates:

The outcomes that obtainable in Tables (1, 2 and 3) exposed that sown dates significantly affected germination anddead seedpercentage, mean germination time, andcoefficient of velocitypercentage, root length (cm), weight of shoot fresh (g), shoot dry weight (gm),root fresh weight (gm), except energy of germination percentage, shoot length (cm) androot dry weight (gm) insignificantly affected. The tallest shoot (highest percentage of germination (84.66 %), the lowest dead seedpercentage (15.33 %) and the highestcoefficient of velocitypercentage (30.07 5) from sown on mid-May. In addition, the lowest mean of germination time (2.2 day) was obtained from son early on first May. Whereas, the tallest root (6.21 cm), the highest weight of fresh shoot (0.72 g) and root (0.15 g) as well as shoot dry weight (0.18 g) from sown on end-May.Sown on 2nd December maximized the percentage of germination and vigor index that recorded a good quality soybean seed (**Kundu et al., 2016)**.

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Table.1: Average of germination, energy of germination and dead seed percentages, mean germination time and coefficient of velocity percentage as influenced by sowing date, soybean cultivars and phosphate fertilization rates.

Characters / Treatment	Germination %	Energy of Germination %	Dead seed %	Mean germination time	Coefficient of velocity
A-Sowing date:					
1 May	67.81	37.48	32.00	2.20	29.19
15 May	84.66	40.63	15.33	2.74	30.07
31 May	84.55	49.14	15.44	2.93	28.22
F. test	*	N.S	*	*	*
LSD at 5%	6.01	---	5.96	0.03	0.88
B-Soybean Cultivars:					
Giza 111	81.22	41.33	18.77	2.64	29.65
Giza 22	78.33	43.25	21.48	2.62	29.10
Crawford	77.48	42.66	22.51	2.60	28.72
F. test	*	*	*	*	N.S
LSD at 5%	6.01	10.79	5.96	0.03	---
C-Phosphorus fertilization:					
0 kg P_2O_5/ha	77.66	42.55	22.14	2.65	28.03
37.2 kg P_2O_5/ha	82.88	44.25	17.11	2.67	28.95
74.4 kg P_2O_5/ha	76.48	40.44	23.51	2.54	30.50
F. test	NS	NS	NS	*	*
LSD at 0.05	---	---	---	0.02	1.43

3.2. Performance of soybean cultivars:

Average of germination and energy of germination percentages and dead seedpercentage, mean germination time, andcoefficient of velocitypercentage, shoot length (cm), root length (cm), shoot fresh weight (gm), shoot and root dry weight (gm) significantly affected by studied soybean cultivars,except, coefficient of velocitypercentage, root and shoot fresh weight (gm) insignificantly influenced. The results clearly revealed that the highest percentage of germination (81.22 %), soot length (6.52 cm) and root length (6.26 cm) was recorded from sown Giza 111 cultivar. The highest energy of germination (43.25 %), shoot (0.16 g) and root (0.2 g) dry weight were recorded from sown Giza 22 cultivar. In addition, sown Crawford cultivar produced the highestdead seedpercentage (22.51 %) and the lowest mean germination time (2.6 day). The JS-335 variety recorded the highest increase in germination percentage and seedling vigour index. Germination percentage, seedling vigour index and seedling dry weight decreased progressively as sowing delayed **(Vidyapeeth, 2002**). Sown at different dates affect seed productivity andproducing good quality seed **(Rahman et al., 2005).**The Giza 21 variety topped other varieties in the seedling vigor index; however, Giza 35 variety produced the latest germination time**(Kandil et al., 2015).**

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Table.2: Average of shoot and root length (cm), weight of freshshoot and root (g),weight of dryshoot and root (g)as influenced by sowing date, soybean cultivars and phosphate fertilization rates.

Characters / Treatment	Shoot length (cm)	Root length (cm)	Shoot fresh weight	Root fresh weight	Shoot dry weight	Root dry weight
A-Sowing date:						
1 May	5.83	6.19	0.53	0.11	0.14	0.01
15 May	6.56	6.06	0.66	0.12	0.14	0.01
31 May	6.97	6.21	0.72	0.15	0.18	0.02
F. test	N.S	*	*	*	*	N.S
LSD at 5%	--	1.18	0.04	0.03	0.01	---
B-Soybean Cultivars:						
Giza 111	6.52	6.26	0.61	0.12	0.15	0.01
Giza 22	6.33	6.10	0.65	0.13	0.16	0.02
Crawford	6.05	6.09	0.64	0.12	0.15	0.01
F. test	*	*	N.S	N.S	*	*
LSD at 5%	0.09	1.18	---	--	0.01	0.01
C-Phosphorus fertilization:						
0 kg P_2O_5/ha	6.32	6.01	0.60	0.13	0.13	0.01
37.2 kg P_2O_5/ha	6.46	6.16	0.64	0.12	0.16	0.01
74.4 kg P_2O_5/ha	6.63	6.28	0.67	0.13	0.17	0.03
F. test	*	*	*	N.S	*	*
LSD at 0.05	0.09	1.32	0.03	---	0.01	0.01

3.3. Effect of phosphorus fertilizer rates:

Average of mean germination time andcoefficient of velocitypercentage**,** shoot length (cm), root length (cm), shoot fresh weight (gm),shoot and root dry weight (gm) significantly affected due to different phosphate fertilization rates, except, germination and energy of germination and dead seedpercentage and root fresh weight (gm) insignificantly affected as shown in Tables (1 and 2). The results indicated that the lowest mean germination time (2.54 day)and maximum percentage of coefficient of velocity(30.5 %), tallest shoot (6.63 cm) and root (6.28 cm), shoot fresh weight (0.67 g), shoot (0.17 g) and root (0.03 g) were obtained fromfertilizationof phosphate at a rate of74.4 kg P_2O_5/ha.Fertilization with K, Zn, and P enhanced seed viability and seedling vigor (**Sawan et al., 2011).**Extreme in P and K fertilization rates can result in lower seed viability and vigor**(Krueger et al., 2013).**

3.4. Interaction Effects:

3.4.1. Interaction between sowing dates and soybean cultivars:

Means ofmean germination time,coefficient of velocitypercentage,shoot length (cm), weight of fresh shoot and root (g) significantly influenced by the interactiveamong sowing dates and soybean cultivars, and insignificantly influenced germination, energy of germination and dead seedpercentages, root length (cm), weight of dry shoot and root (g). The results graphically illustrated in Figs. 1, 2, 3, 4 and 5clearly showed thatthe lowest mean germination time (3.11 day), the highest percentageof coefficient of velocity (30.7 %), the tallest shoot (7.7 cm)the highest fresh weight of shoot (0.79 g)and root (0.18 g). However, the lowest values were obtained from sown Giza 22 cultivar on end May. The JS-335 variety recorded the highest increase in germination percentage and seedling vigour index. Germination percentage, seedling vigour index and seedling dry weight decreased progressively as sowing delayed **(Vidyapeeth, 2002**).

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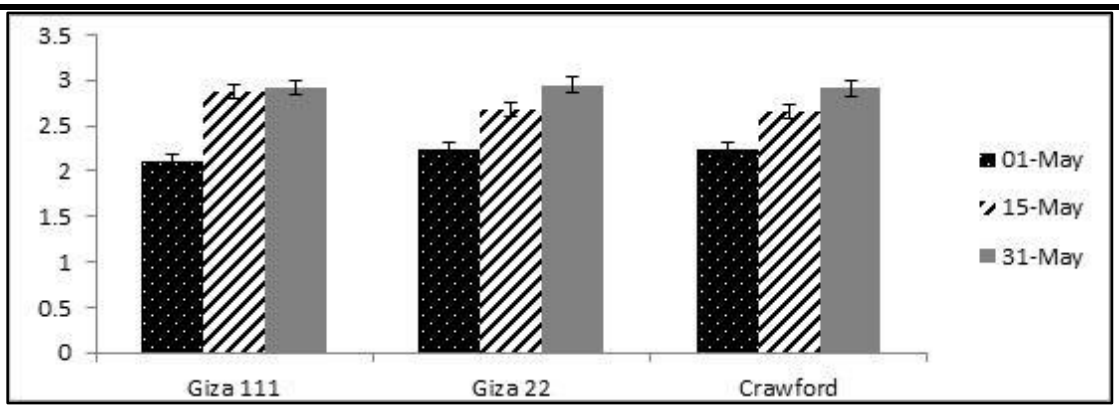

Fig.1: Average of main germination time as influenced by the interactive among soybean cultivars and sowing date.

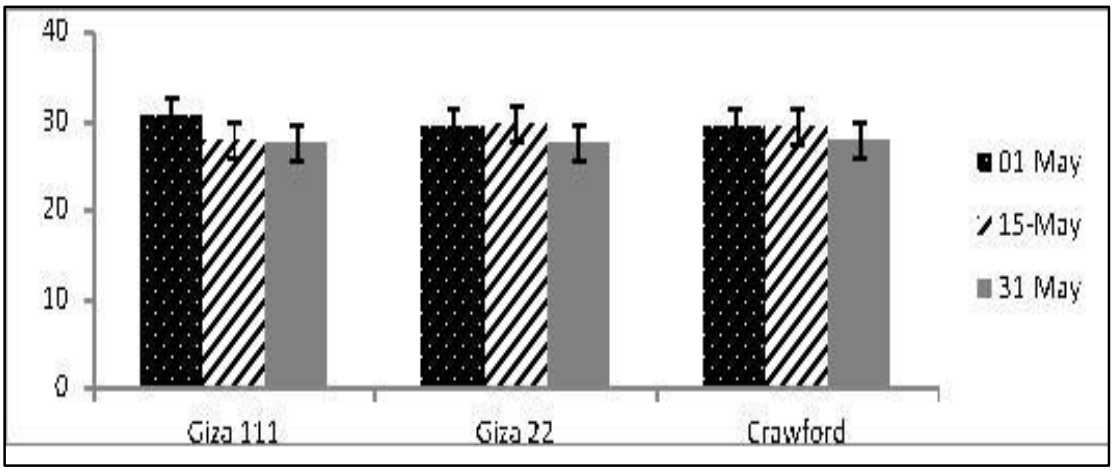

Fig.2: Average of coefficient of velocity as affected by interaction between soybean cultivars and sowing date.

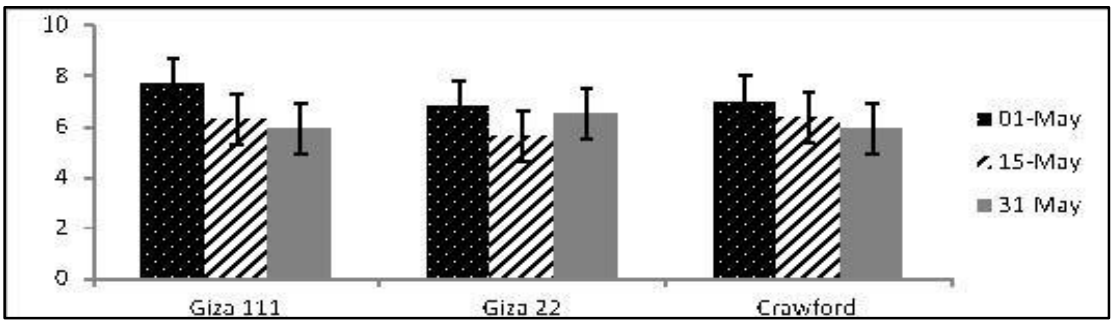

Fig.3: Average of shoot length (cm) as influenced by interaction between soybean cultivars and sowing date.

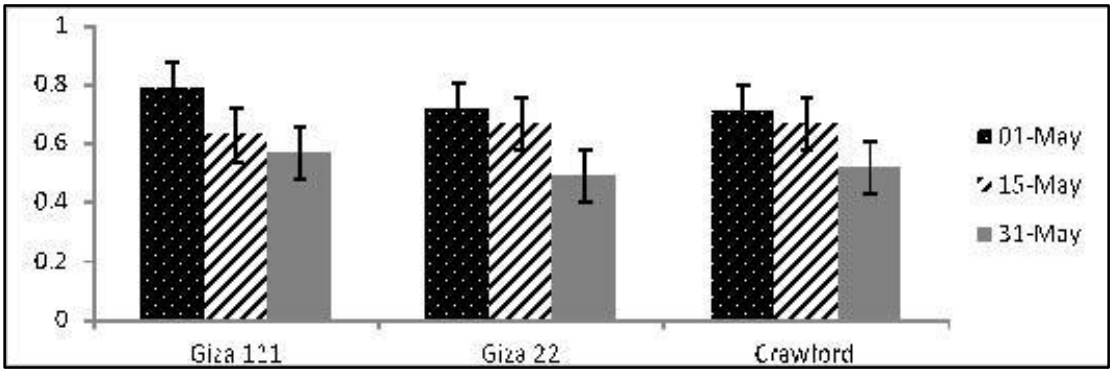

Fig. 4: Average of shoot fresh weight (g) as influenced by the interactive among soybean cultivars and sowing date.

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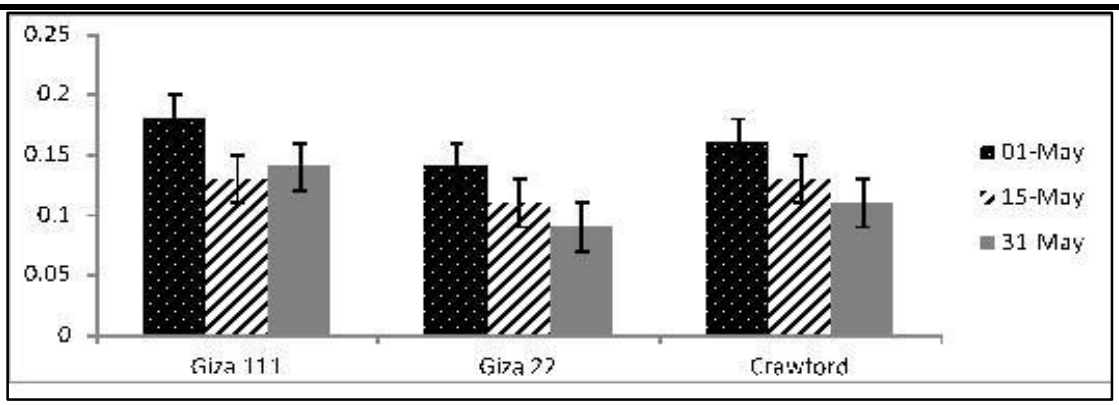

Fig.5: Average of root fresh weight (g)as influenced by interaction between soybean cultivars and sowing date.

3.4.2. Interaction between sowing dates and phosphorus fertilizer rates:

Means of energy of germination and coefficient of velocity percentage, root length (cm) andweightof fresh root (g), significantly affected by the interaction between sowing dates and phosphorus fertilizer rates but, insignificantly influenced mean germination time,shoot length (cm), weight of fresh shoot (g),dry weight of shoot and root (g).The results graphically illustrated in Figs. 6, 7, 8 and 9 clearly showed thatthe highest percentages ofenergy of germination (51.8 %), coefficient of velocity (31.7 %), the tallest root (6.89 cm) and the great root fresh weight (0.17 g). However, the lowest values were produced from sown on end May without phosphorus fertilizer supplying.Extreme in P and K fertilization rates can result in lower seed viability and vigor**(Krueger et al., 2013).**

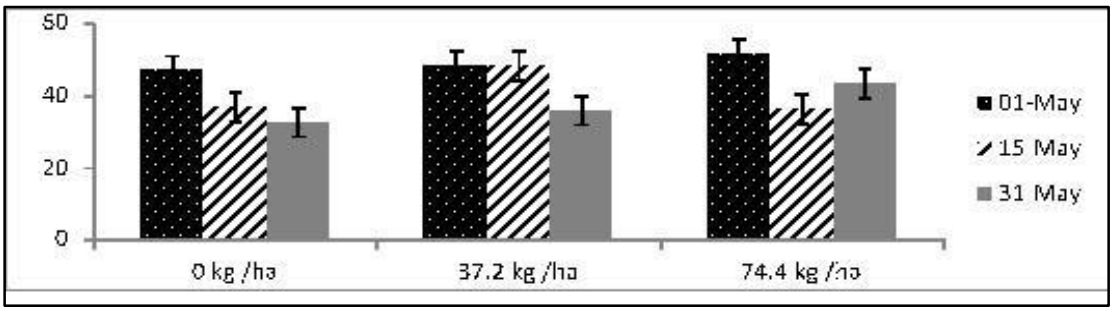

Fig. 6. Average of energy of germination as affected by interaction between phosphate fertilization and sowing date.

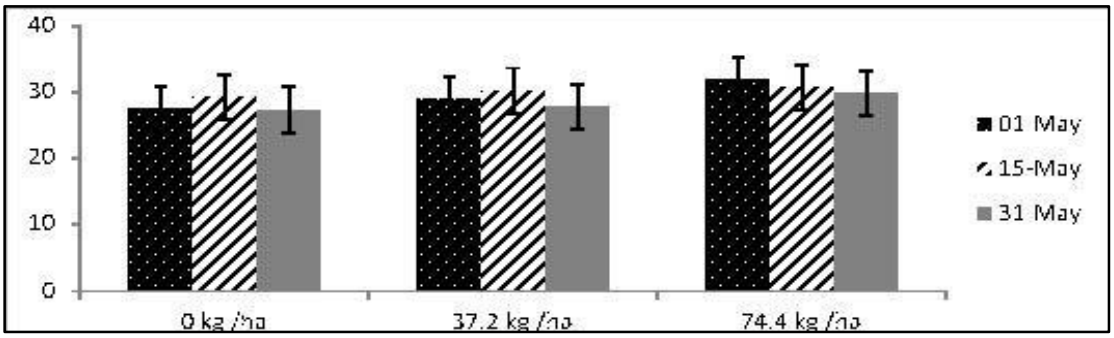

Fig. 7. Average of coefficient of velocity as affected by interaction between phosphate fertilization and sowing date.

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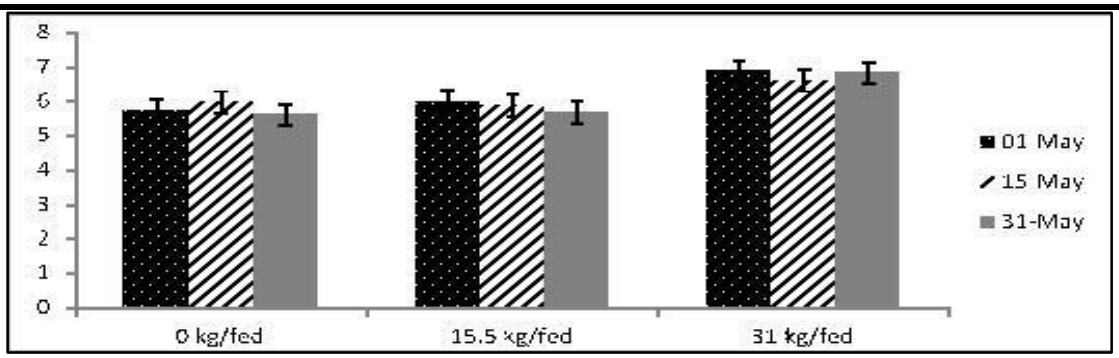

Fig. 8. Average of root length as influenced by the interactive among sowing date and phosphate fertilization rates.

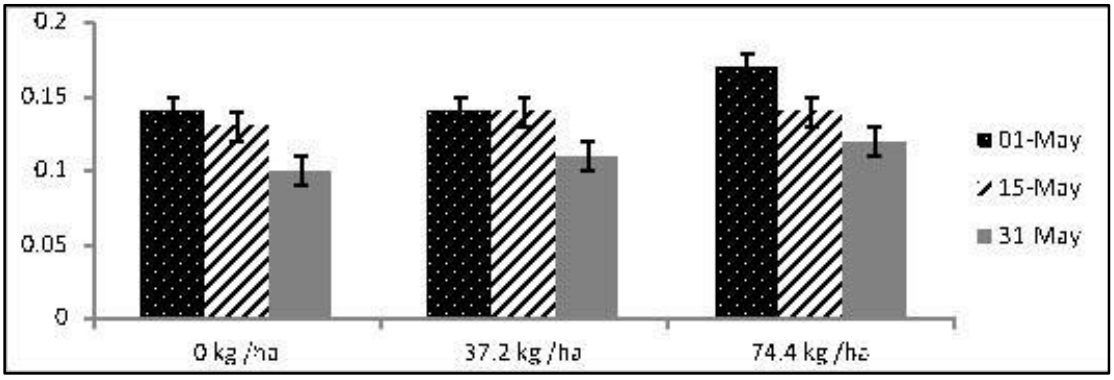

Fig. **9**. *Average of root fresh weight (g)as influencedby interaction between sowing date and phosphate fertilization rates.*

3.4.3. Interaction between soybean cultivars and phosphorus fertilizer rates:

Means ofgermination and dead seedpercentages,shoot and root length (cm), shoot fresh and dry weight (g)significantly affected by the interaction between soybean cultivars and phosphorus fertilizer ratesbut, insignificantly influenced mean germination time, energy of germination root fresh and dry weight (g).The results graphically illustrated in Figs. 10, 11, 12, 13, 14 and 15 clearly showed that highest % of germination (86.0 %), the lowest dead seed % (14.0 %), tallest shoot (7.1 cm) and root (7.0 cm), weight of fresh shoot (0.72g) and dry (0.19 g) were obtained from sown Giza 111 cultivar and phosphorus fertilization at the rate of74.4 kg P_2O_5/ha. However, the lowest values were recorded from sown Crawford cultivar and without phosphorus fertilization.

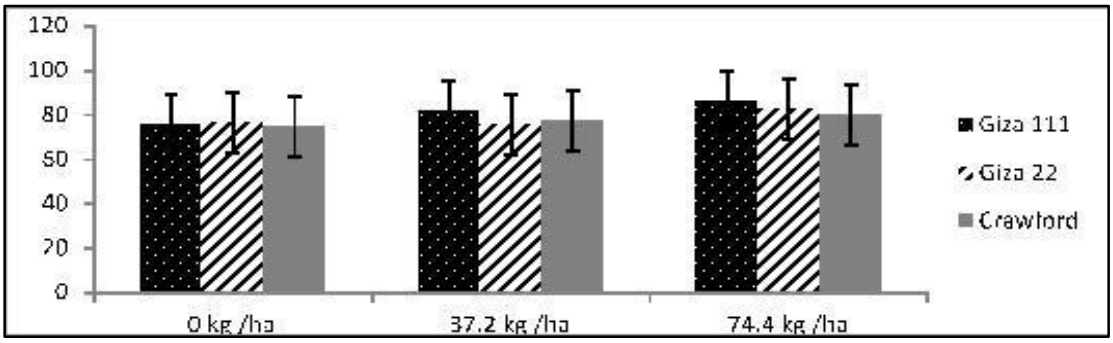

Fig. **10**. *Average of germination % as influenced by the interactive among soybean cultivars and phosphate fertilization rates.*

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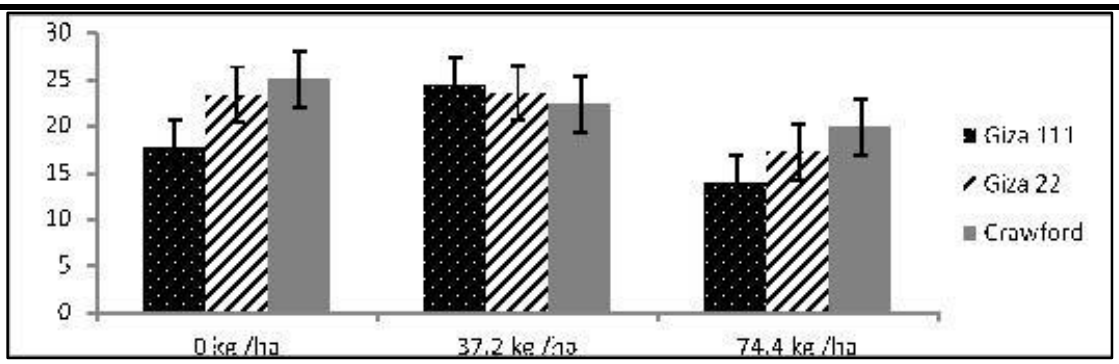

Fig.11. Average of dead seed% as influenced by interaction among soybean cultivars and phosphate fertilization rates.

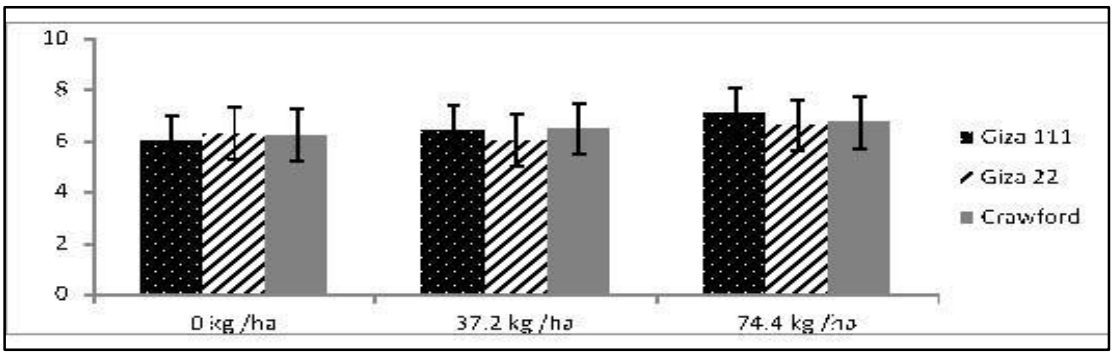

Fig.12. Average of shoot length (cm) as affected by interaction between soybean cultivars and phosphate fertilization rates.

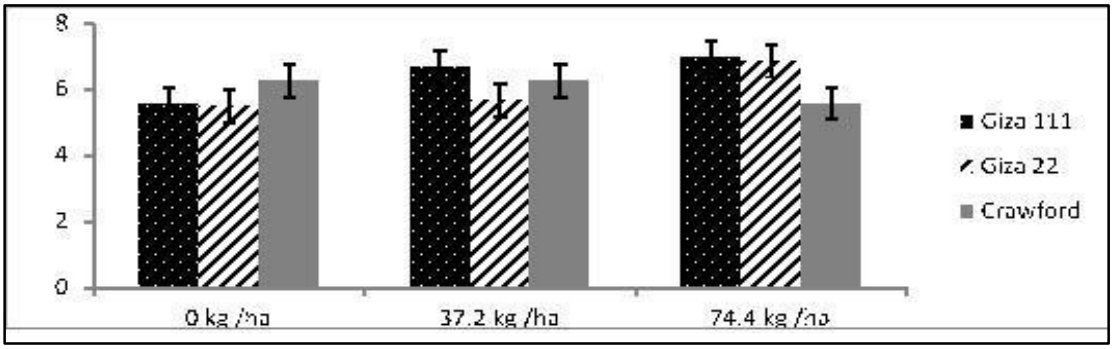

Fig. 13. Average of root length (cm) as affected by interaction between soybean cultivars and phosphate fertilization rates.

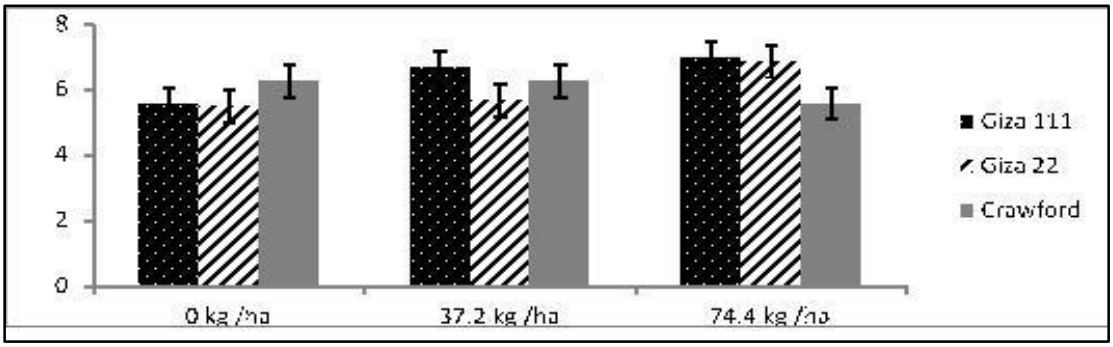

Fig. 14. Average weight offreshshoot (g) as affected by interaction between soybean cultivars and phosphate fertilization rates.

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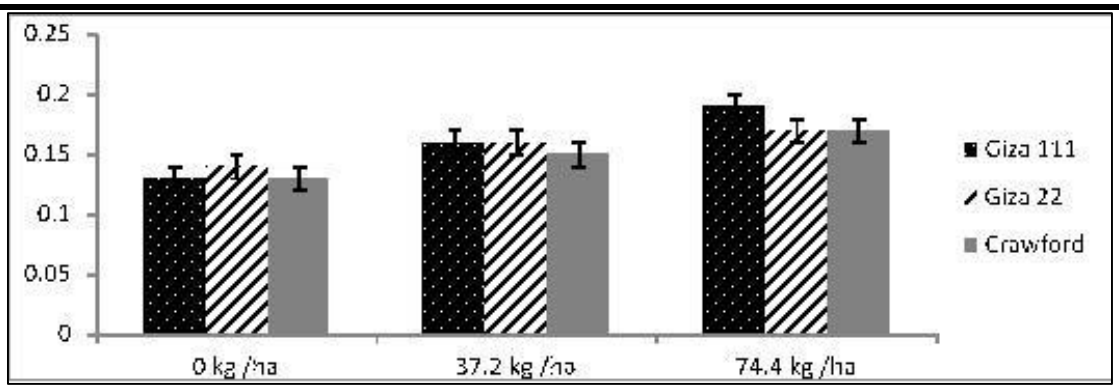

Fig. 15. Average weight ofdryshoot (gm) as affected by interaction between soybean cultivars and phosphate fertilization.

3.4.4. Interaction among sowing dates, soybean cultivars and phosphorus fertilizer rates:

Means of percentage of germination and energy of germination dead seed percentages, mean germination time, shoot and root length (cm), shoot fresh and dry weight (g),root fresh and dry weight (g) insignificantly affected by the interaction among sowing dates, soybean cultivars and phosphorus fertilizer rates.

IV. CONCLUSION

It could be concluded that seed Giza 111 cultivar recorded the best in seed viability when sown on first May and fertilized with phosphorus fertilizer at a rate of 74.4 kg P_2O_5/ha.

REFERENCES

[1] Abdel-Baki, A. A. and J. D. Anderson 1973.Viability and leaching of sugars from germinating barley. Crops Sci., 10: 31 – 34.https://dl.sciencesocieties.org/publications/cs/abstracts/10/1/CS0100010031

[2] Ellis, R.A. and E.H. Roberts 1981. The quantification of ageing and survival in orthodox seeds. Seed Sci. Technol., 9: 373-409.http://agris.fao.org/agris-search/search.do?recordID=XE8182678

[3] Gomez, K.A. and A.A. Gomez 1991.Statistical Procedures in Agricultural Research, John Wiley and Sons, New York.http://pdf.usaid.gov/pdf_docs/PNAAR208.pdf

[4] Islam, M.M. and M. A. Karim 2010. Evaluation of Rice *Oryza sativa L*. genotypes at germination and early seedling stage for their tolerance to salinity. The Agric., 8 (2): 57 – 65.http://www.banglajol.info/index.php/AGRIC/article/view/7578

[5] ISTA Rules 2016.International seed testing association. ISTA Germination Sec. Chapter 19: pp. 19 – 41.https://www.seedtest.org/upload/cms/user/OGM15-05-Proposed-Changes-to-the-ISTA-Rules-for-2016.pdf

[6] Kandil A.A., A.E. Sharief and Kh. R. Ahmed 2015. Performance of some soybean Glycine max (L.) Merrill. Cultivars under salinity stress to germination characters. International Journal of Agronomy and Agricultural Research (IJAAR). 6(3): 48-56.http://www.innspub.net/wp-content/uploads/2015/03/IJAAR-V6No3-p48-56.pdf

[7] Kandil A.A., A.E. Sharief and M.S Sheteiwy 2013. Seedling Parameters of Soybean Cultivars as Influenced with Seed Storage Periods, Conditions and Materials. International Journal of Agriculture Sciences, 5(1): 330-338. https://bioinfopublication.org/files/articles/5_1_1_IJAS.pdf

[8] Karim, M.A., N. Utsunomiya and S. Shigenaga 1992. Effect of sodium chloride on germination and growth of hexaploid triticale at early seedling stage. Japanese Journal of Crop Science,61: 279 – 284.https://www.jstage.jst.go.jp/article/jcs1927/61/2/61_2_279/_article

[9] Krueger, K., A. S. Goggi, A. P. Mallarino and R. E. Mullen 2013. Phosphorus and Potassium Fertilization Effects on Soybean Seed Quality and Composition. Crop Science, 53(2): 602-610. DOI: 10.2135/cropsci2012.06.0372.

[10] Kundu, P. K., T. S. Roy, Md. S. H. Khan, K. Parvin4 and H. E. M. K. Mazed 2016. Effect of Sowing Date on Yield and Seed Quality of Soybean. Journal of Agriculture and Ecology Research International, 9(4): 1-7.DOI : 10.9734/JAERI/2016/29301

[11] Rahman, M. M., Hampton, J. G. and Hill, M. J. 2005. Soybean seed yield as affected by time of sowing in a cool temperature environment. Seed Science and Technology, 7: 1-

15.https://www.seedtest.org/en/seed-science-and-technology- content---1--1084.html

[12] Rahman, M. M., M. M. Rahman and M. M. Hossain 2013. Effect of Sowing Date on Germination and Vigour of Soybean (Glycine max (L.) Merr) Seeds. The Agriculturists 11(1): 67-75.DOI: http://dx.doi.org/10.3329/agric.v11i1.15245

[13] Ruan, S., Q,Xue and K.Tylkowska 2002. Effects of seed priming on germination and health of rice *Oryza sativa L*. seeds. Seed Science and Technology, 30: 451-458.http://www.uaiasi.ro/CERCET_AGROMOLD/CA3-15-05.pdf

[14] Russell, D.F. 1986.MSTAT-C computer based data analysis software Crop andSoil Science Department, Michigan State University USA.https://msu.edu/~freed/mstatc.htm

[15] Sawan, Z.M., A.H. Fahmy and S. E. Yousef 2011. Effect of potassium, zinc and phosphorus on seed yield, seed viability and seedling vigor of cotton (Gossypium barbadense L.). Archives of Agronomy and Soil Science, 57(1): 75-90. http://dx.doi.org/10.1080/03650340903222328

[16] Snedecor GW and WG. Cochran 1980. Statistical Methods. 7ThEd. Iowa State University Press, Iowa, USA, ISBN-10: 0-81381560-6, Pp: 507. https://www.amazon.com/Statistical-Methods-Seventh-isbn-0813815606/dp/B0012S4NIE

[17] Vidyapeeth, M.P.K. 2002. Effect of sowing dates on seed yield, yield yield component characters and seed quality of soybean (Glycine max (l.) Merrill) in Kharif season. M. Sc. Thesis Department of Agricultural Botany, Ahmednagar Maharashtra, India. http://krishikosh.egranth.ac.in/bitstream/1/5810004414/1/28_C.pdf

[18] Waller R.A. and B.D. Duncan 1969. A bays rule for the symmetric multiple comparison problem. J. Amer. Assoc., 64, 1484-1503.https://www.jstor.org/stable/2286085?seq=1#page_scan_tab_contents