Effect of Sowing Dates on Growth, Yield, and Its Components of Grass Pea (Lathyrus Sativus) Varieties under Rainfed Condition in Sulaimani Region

ABSTRACT

The study was carried out in Sulaimani region at Qliasan location during the winter season of 2019-2020. A factorial experiment was conducted by using randomized complete block design with three replications. It was aimed to evaluate the effect of three sowing dates on growth, yield, and its components of grass pea varieties under rainfed conditions of Sulaimani Region. Three levels of sowing dates: 15th October (S1), 1st November (S2), and 15th November (S3) 2019 was applied for four varieties of grass pea (IF003, IF133, IF102, IF067), originated from different regions. The results of the experiment showed significant values for plant height (59.391 cm), days to 50% flowering (125.307), days to maturity (174.333), seed yield (4013.920 kg ha⁻¹) and biological yield (18004.514 kg ha⁻¹) at the third sowing date (S3). The second sowing date resulted in the highest no of pods plant⁻¹ (27.417) harvest index (0.403). The first sowing date had recorded the highest number of seeds (4.333) and seed yield (5599.141 kg ha⁻¹).

© 2021 TJAS. College of Agriculture, Tikrit University

INTRODUCTION

Grass pea (Lathyrus sativus L.) graded as one of the essential food legumes for the developing countries with a great forage production potential. This species is the most important for Lathyrus genus as a food source (Biswas, 2007). This crop is used since ancient times as a food and fodder for human and animal, respectively (Hanbury et al., 2000). Grass pea is known with different names, such as chickling pea, chickling vetch, dogtooth pea, grass pea vine, Indian pea, Riga pea, wedge pea vine. It has a high yield potential in some countries of West Asia and North Africa, such as Nepal, Bangladesh, India, and Ethiopia, in addition to drought and salt tolerance, disease resistance, considering a vital food legume crop there (Mahboob, 2000; Polignano, 2003; Campbell, 1997). Lathyrus is rich in protein (28%) and minerals especially calcium, phosphorus and iron (Bhagat et al., 2015). Dried seeds of Lathyrus contain high protein rate (31.9%), carbohydrates (53.9%) (Tomar et al., 2011). Protein content of grass pea seeds is equivalent to or
even higher than some other commonly consumed grain legumes, such as pea (Zambre, 2002). In India, grass pea is cultivated in a wide area of 495300 hectares with the production of 456000 tones, with an average rate of 921 kg ha\(^{-1}\) (Anonymous, 2014). Hence, it is a highly yield and, drought tolerance crop and consumed as one of the main foods in northern India, producing reliable yield in a soil when other crops fail (Sharma, et al., 2000).

In Asia and East Africa, grass pea is a cool-season legume widely grown for human consumption and livestock feed. A better understanding of the agronomic significance of the planting date, growth, and photoperiod impact will certainly lead to improved management strategies for grass pea cultivation in different spots around the world. Sowing date moderately influences the quantity grass pea seed, by exposing the crops to diverse environmental conditions (Singh, 1998). Sowing date affects the seed contents mainly protein percentage, through prevailing the pattern of thermal conditions during the seed-filling period (Alignan, 2009). In general, four weeks delay in sowing date of forages, is remarkably declines total dry matter products, due to the high raising temperature from the optimum range, especially in the early growth period (Keogh, 2001). Earlier sowing (late April to early May), conducted by Connor (1993), increased \(\text{N}_2\) fixation and dry matter production compared to late sowing dates. Different growth conditions of early sowing, such as temperature, precipitation, and growth cycles have been identified to ensure good seed germination, as well as the timely appearance of seedlings and optimum root system growth. Grass pea of early-spring sowing produced more than 6400 kg ha\(^{-1}\) dry matter for a total of 75 days life period with 23 to 55% of Nitrogen (Rao et al., 2005b).

Grass pea planting in Bermuda grass pastures (Cynodon dactylon Pers.) allow the quality of forage to exceed that of forage generated on pastures receiving 90 kg ha\(^{-1}\) N fertilizer (Rao et al., 2007). Sowing date is largely determined by the time when monsoon rains end, in addition to soil type, and soil moisture profile during last season period (October). In some rainfed areas of India such as Madhya Pradesh, \textit{Lathyrus} is grown as a mixed crop with other cereals such as wheat, chickpea, barley, and linseed (Arora, R.K. et al. 1995). The main objective of this study was to determine the most appropriate Grass pea (\textit{Lathyrus sativus} L.) Varieties and the most suitable sowing date under rainfed condition of Sulaimani.

MATERIALS AND METHODS

Climatic conditions of Sulaimani region

Sulaimani region is a semi-arid environment: cold and wet in winter, hot and dry in summer. The average temperature from July to August is between 39-43\(^\circ\)C and often reaching nearly 50\(^\circ\)C. October has temperature ranged from 24-29\(^\circ\)C, while gradually cooling down in November. Rainfall normally starts from November to till the end of April (Mahmood, et al., 2019).

Field Experiment

This study was carried out in Sulaimani region at Qliasan location during the winter season of 2019-2020. Three sowing dates of October 15\(^{th}\) (S1), 1\(^{st}\) November (S2), and 15\(^{th}\) November (S3), was applied using four varieties of grass pea that originated from different region sources (IF003, IF133, IF102, IF067) (V1), (V2), (V3) and (V4)). Seeds were planted on lines in plots of 3m\(^2\), each plot comprised of 5 lines, with 2m length each and 0.3m distance between the lines. The seed rate of 80 kg ha\(^{-1}\) was applied for all the varieties at all three planting dates. The varieties were grown in fallow land with no fertilization under rainfed conditions. Mechanical weed control was applied to the experiment.

Statistical analysis

A Factorial experiment designed in Complete randomized Block Design (CRBD), with three replications, according to the procedure outlined by Steel and Torrie (1986). All possible
comparisons among the means would carry out using L.S.D test (Least Significant Difference) at a significant level of 5%.

**Plant measurements**

Five plants were randomly selected from each designated for recording the measurements of growth, forage yield components, and yield related traits.

**Growth and Forage Yield Components:**

Plant height (cm), days to 50% flowering, days to maturity, no. of branches/plant, leaf dry weight (g), stem dry weight (g) and leaf stem ratio.

**Seed Yield Components:**

Data were recorded from the whole plot for seed yield, biological yield, and harvest index, while for other traits the average value from five plants in each plot was recorded. The measured traits include; pod number per plant, seed number per pod, and seed yield in kg ha\(^{-1}\) as a rate of yield per hectare, counted by converting the yield of plot area into a hectare, 100 seed weight, the biological yield was the average weight of the whole plants for each plot converted to kg/ha, and Harvest index (HI), counted in ratio of seed yield to total biological yield of the plant, according to Rehman *et al.* (2009).

Harvest Index = Seed yield (kg ha\(^{-1}\)) / Biological yield (kg ha\(^{-1}\))

**RESULTS AND DISCUSSION**

In the analysis of variance (Table 1), it is realized that plant height was highly significant for sowing dates, while for varieties and their interactions no significant difference was recorded. In Table 2 it is indicated that the traits; plant height, days to %50 flowering, days to maturity, no of pod plant\(^{-1}\), no of seeds plant\(^{-1}\), seed yield, biological yield and harvest index were highly significant for sowing dates, while these traits had no significant differences for different varieties and their interaction with sowing dates.

| S.O.V       | d.f | Plant height (cm) | No. of branch Plant-1 | Days to 50% Flowering | Days to maturity | Leaf dry weight (g) | Stem dry weight (g) | Leaf stem ratio |
|-------------|-----|-------------------|-----------------------|----------------------|-----------------|---------------------|--------------------|-----------------|
| Sowing date | 2   | 739.389**         | 4.454 n.s             | 3872.502**           | 654.996**       | 1.232 n.s           | 0.281 n.s          | 0.316 n.s       |
| Varieties   | 3   | 8.627 n.s         | 1.849 n.s             | 3.245 n.s            | 0.062 n.s       | 0.057 n.s           | 0.122 n.s          |                 |
| S X V       | 6   | 75.359            | 1.792                 | 2.776                | 11.930          | 0.153               | 0.313              | 0.265           |
| Error       | 22  | 57.983            | 1.689                 | 5.077                | 14.570          | 0.460               | 0.381              | 0.344           |

| S.O.V       | d.f | No. of pods/plant | No. of seeds/pod | 100 seed weight (g) | Seed yield (kg/ha) | Biological yield (kg/ha) | Harvest index |
|-------------|-----|------------------|-----------------|---------------------|-------------------|-------------------------|---------------|
| Sowing date | 2   | 136.861**        | 9.694 n.s       | 4.440 n.s           | 7756312.782**     | 133318947.099*          | 0.082**       |
| Varieties   | 3   | 24.519 n.s       | 1.361 n.s       | 0.813 n.s           | 1086174.66 n.s    | 5804655.612 n.s         | 0.004 n.s     |
| S X V       | 6   | 7.269            | 0.139           | 0.610               | 455249.120       | 3689415.902            | 0.004         |
| Error       | 22  | 23.543           | 0.876           | 1.788               | 832683.896       | 24653880.579           | 0.006         |
Results of Table 3 revealed that the effect of varieties on some growth, forage yield characters of grass pea was found to be not different significantly for all characters. This could refer to highly relatedness of the varieties used in the study, or they may have same origin.

### Table 3: Effect of Varieties on some growth, forage yield characters of grass pea

| Varieties | plant height (cm) | No. of branch Plant$^1$ | Days to 50% flowering | Days to maturity | leaf dry weight (g) | Stem dry weight (g) | Leaf stem ratio |
|-----------|------------------|-------------------------|-----------------------|-----------------|-------------------|-------------------|----------------|
| V1        | 51.425           | 6.293                   | 113.734               | 165.561         | 1.936             | 1.75              | 1.287          |
| V2        | 52.62            | 5.874                   | 113.396               | 167.091         | 1.756             | 1.761             | 1.104          |
| V3        | 50.76            | 5.273                   | 112.711               | 169.327         | 1.914             | 1.923             | 1.137          |
| V4        | 50.39            | 6.161                   | 114.128               | 166.463         | 1.828             | 1.821             | 1.006          |
| LSD (p≤0.05) | 7.444 n.s | 1.271 n.s | 2.203 n.s | 3.732 n.s | 0.663 n.s | 0.603 n.s | 0.574 n.s |

### Plant height

Data represents in Table 4 showed that the effect of sowing dates on growth, forage yield components of grass pea were highly significant for characters plant height, days to 50% flowering, and days to maturity, except leaf dry weight, stem dry weight and leaf stem ratio. Plant heights were highly significant by varieties. The highest means of plant height (59.391 cm) was observed under S3 sowing date. While the lowest mean of plant heights was 43.717cm gained when planted for S1. This result would probably due to timely sowing that may have had favorable climatic conditions during crop growth in terms of temperature and other parameters. The current findings are in close compliance with those of Kushwaha, et al., (2006) and Gohil, et al., (2016).

### Days to 50% flowering

Data presented in Table 4 confirmed highly significant affected of sowing dates on the number of days from sowing to 50% flowering. The longest days spent was 125.307, obtained by the third sowing date (S3). While first sowing date (S1) spent less days to 50% flowerings (92.819 day). This vast differences in the days need to start 50% flowering could be due to differences in the environmental condition especially temperature and water availability, that affected the starching of growth and development of plants to approach flowering stage.

### Table (4): Effect of Sowing dates on growth, forage yield components of grass pea

| Seeding Rate | plant height(cm) | No. of Branch Plant-1 | Days to %50 flowering | Days to maturity | leaf dry weight (g) | Stem dry weight (g) | Leaf stem ratio |
|--------------|------------------|-----------------------|-----------------------|-----------------|-------------------|-------------------|----------------|
| S1           | 43.717           | 6.523                 | 92.819                | 159.567         | 2.079             | 1.791             | 1.302          |
| S2           | 50.789           | 5.783                 | 122.350               | 167.432         | 2.005             | 1.977             | 1.121          |
| S3           | 59.391           | 5.306                 | 125.307               | 174.333         | 1.491             | 1.673             | 0.978          |
| LSD (p≤0.05) | 6.447 **         | 1.100 n.s             | 1.908 **              | 3.232**         | 0.574 n.s         | 0.523 n.s         | 0.497 n.s |

### Days to maturity

Table 4 shows that the number of days from sowing to maturity was affected by sowing dates with highly significant difference. The maximum period lasted 174.333 days, recorded by planting at the third sowing date (S3). While planting on the first sowing date (S1) spent a minimum period to maturity (159.567 days). The plants matured after an average of 157-160 days. Results of Table 5 revealed that the effect of sowing date on seed yield and its components of grass pea was not significantly different for all characters.
Table (5): Effect of grass pea varieties on seed yield and its components

| Varieties | No. of pods/plant | No. of seeds/pod | 100 seed weight (g) | Seed yield (kg/ha) | Biological yield (kg/ha) | Harvest index |
|-----------|-------------------|-----------------|---------------------|-------------------|--------------------------|--------------|
| V1        | 27.556            | 3.778           | 8.857               | 5029.612          | 15055.94                 | 0.351        |
| V2        | 24.889            | 3.111           | 9.576               | 4277.86           | 13954.15                 | 0.318        |
| V3        | 24.778            | 3.444           | 9.302               | 4811.429          | 14356.48                 | 0.366        |
| V4        | 23.667            | 2.889           | 9.143               | 4846.281          | 15778.76                 | 0.339        |
| LSD (p≤0.05) | 4.744 n.s           | 0.915 n.s       | 1.307 n.s           | 892.105 n.s      | 4854 n.s                  | 0.077 n.s    |

Table (6) shows that a higher and significant number of pods plant\(^1\) (27.417) was recorded for the second sowing date (S2). While the minimum value of no of pods/plant (21. 333) was recorded by the third sowing date (S3). This result is likely due to timely planting of the crop and exposing to favorable climatic condition during the whole growth cycle, hence different consequent phases of the plant were completed at suitable time-periods, which eventually resulted in the production of more capsules and seed yield per a plant. Our results here would confirms the results obtained previously (Ganga et al., 2015, Maurya, et al., 2017).

Table (6): Effect of Seeding dates of grass pea on seed yield and its components

| Seeding Rate | No. of pods/plant | No. of seeds/pod | 100 seed weight (g) | Seed yield (Kg/ha) | Biological yield (kg/ha) | Harvest index |
|--------------|-------------------|-----------------|---------------------|-------------------|--------------------------|--------------|
| S1           | 26.917            | 4.333           | 9.643               | 5599.141          | 15005.467                 | 0.379        |
| S2           | 27.417            | 2.917           | 9.493               | 4573.326          | 11349.021                 | 0.403        |
| S3           | 21.333            | 2.667           | 8.523               | 4013.920          | 18004.514                 | 0.249        |
| LSD (p≤0.05) | 4.108**           | 0.793**         | 1.132 n.s           | 772.586**         | 4204 *                    | 0.066 **     |

Results of seed yield and its parameters in Table 6 confirm that the first sowing date (S1) produced a higher and significant number of seeds plant\(^1\) reached (4.333). While the minimum value of No. of seeds pod\(^1\) (2.667) was recorded for the third sowing date (S3). These results obtained here are in agreement with what was investigated by Saoji et al. (2007) and Gohil et al. (2016).

Seed yield kg ha\(^{-1}\)

Data presented in Table 6 revealed that the first sowing date (S1) recorded significantly higher seed yield (5599.141 kg ha\(^{-1}\)), however the minimum value of 4013.920 kg seed yield ha\(^{-1}\) was recorded for the third sowing date (S3). These results are in accordance to what was obtained by some other researchers (Kushwaha, et al., 2006, Shoji, et al. 2007, and Gohil et al. 2016).

Biological yield kg ha\(^{-1}\)

It is clear from data presented in Table 6 that the biological yield showed a significant response to different sowing dates. The maximum biological mass (18004.514) kg ha\(^{-1}\) obtained at the third sowing date (S3), while minimum values of biological yield was 11349.021 kg ha\(^{-1}\) that obtained when the grass pea planted at the second sowing date (S2). Piergiovanni, (2010) reported a significant increase and decline in biological and seed yield of different grass pea ecotypes under different climatic conditions.

Harvest index %

Second sowing date (S2) indicated a maximum harvest index (0.403), while minimum values of harvest index recorded was 0.249 that obtained under the third sowing (S3), see Table 6. These differences among varieties might refer to genetic makeup of the studied genotypes, giving
variable performance for different characteristics studied. The results obtained and the explanation here are in accordance to the outcomes of Arslan (2017).

Results of Table 7 revealed that the effect of interactions of Varieties and seeding dates on some growth, forage yield, seed yield, and its components of grass pea was found to be not significantly different for all characters.

Table (7): Effect of interactions of grass pea varieties and seeding dates on some growth, forage yield characters

| Varieties x sowing date | plant height (cm) | No. of branch Plant^{-1} | Days to 50% flowering | Days to maturity | leaf dry weight (g) | Stem dry weight (g) | Leaf stem ratio |
|------------------------|-------------------|--------------------------|-----------------------|-----------------|--------------------|--------------------|---------------|
| V.1 X S1               | 39.393            | 7.957                    | 92.710                | 157.198         | 2.164              | 1.320              | 1.709         |
| V.1 X S2               | 51.632            | 6.257                    | 123.383               | 167.257         | 2.131              | 2.056              | 1.178         |
| V.1 X S3               | 63.250            | 4.667                    | 125.110               | 172.227         | 1.511              | 1.873              | 0.974         |
| V.2 X S1               | 41.171            | 6.093                    | 93.806                | 161.098         | 1.771              | 2.110              | 0.990         |
| V.2 X S2               | 58.524            | 6.327                    | 120.673               | 166.404         | 1.728              | 1.798              | 0.964         |
| V.2 X S3               | 58.163            | 5.203                    | 125.708               | 173.772         | 1.769              | 1.375              | 1.359         |
| V.3 X S1               | 46.755            | 5.580                    | 91.852                | 160.504         | 2.238              | 1.923              | 1.320         |
| V.3 X S2               | 46.763            | 4.843                    | 121.818               | 171.781         | 2.146              | 1.879              | 1.401         |
| V.3 X S3               | 58.763            | 5.397                    | 124.464               | 175.695         | 1.358              | 1.969              | 0.689         |
| V.4 X S1               | 47.547            | 6.463                    | 92.910                | 159.469         | 2.144              | 1.812              | 1.187         |
| V.4 X S2               | 46.238            | 6.063                    | 123.526               | 164.284         | 2.014              | 2.173              | 0.943         |
| V.4 X S3               | 57.387            | 5.957                    | 125.947               | 175.637         | 1.325              | 1.476              | 0.888         |
| LSD (p≤0.05)           | 12.894            | 5.754                    | 3.815n.s.             | 6.463 n.s.      | 1.148 n.s.         | 1.045 n.s.         | 0.994 n.s     |

CONCLUSIONS

The result obtained in the current investigation indicated that in general there is no significant differences among the varieties under study, due to sharing their ancestor relation or they came from the same genetic background. However, the results showed that there were significant differences between the treatments for some of the traits studied. The results also illustrate that sowing grass pea at the third sowing date indicated the highest values of plant height, days to 50% flowering, and days to maturity in this study. The second sowing date represented the highest production of grass pea with the highest values of pod number and harvest index on that sowing date. First sowing date, which produced the highest values of seed number and seed yield. Besides, the third sowing date gave the highest biological yield.

REFERENCES

Alignan M, J. Roche, A. Bouniols, M. Cerny, Z. Mouloungui and O. Merah (2009). Effects of genotype and sowing date on phytostanol–phytosterol content and agronomic traits in wheat under organic agriculture. Food Chemistry, 117: 219–225.

Anonymous, 2014. Area, production and yield of lathyrus and mothbean in India. Pulses data book state wise.2, 2.4. Indian Institute of pulse research, Kanpur, India.

Arslan, M., 2017. Fatty Acid characteristics of grass pea (Lathyrus sativus) in an East Mediterranean environment. Cogent Chemistry, 3 (1):1-9

Bhagat G. J., S. R. Kamdi, P. S. Neharkar, S. R. Ghate and P.R. Kadu, 2015. Influence of integrated nutrient management on paddy-lathyrus cropping system in eastern Vidarbha region. International Journal of Tropical Agriculture. 4(2): 16-20.
Biswas, A. K., 2007. Induced mutation in grass pea (*Lathyrus sativus* L.). In: Breeding of neglected and underutilized crops, spices and herbs, (eds. Ochatt, S. and Jain, S.M.). Science Publishers, Jersey, Plymouth: 29-39.

Campbell C. G., 1997. Grass Pea. *Lathyrus sativus* L. Promoting the Conservation and Use of Underutilized and Neglected Crops. Publ. No. 18. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.

Connor GE, J. Evans, N.A. Fettell, I. Bamforth, J. Stuchberry, D.P. Heenan and P.M. Chalk, 1993. Sowing date and varietal effects on the N2 fixation of field pea and implications for improvement of soil nitrogen. Crop and Pasture Science. 44(1), 151 – 163.

Fraser M. D., R. Fychan and R. Jones, 2001. The effect of harvest date and inoculation on the yield, fermentation characteristics and feeding value of forage pea and field bean silages. Grass and Forage Science. 56, 218-230.

Ganga P., R. K. Singh, A. Singh and K. Singh, 2015. Growth, yield and nutrient uptake and quality of Linseed (*Linum usitatissimum* L.) Varieties as Affected by Varying Sowing Dates. Environment and Ecology. 33(1A):271-274.

Gohil J.R., M.D. Kamani, D. Kumar and L.K. Arvadiya, 2016. Performance of linseed (*Linum usitatissimum* Linn.) to different dates of sowing, seed rate and row spacing. Advances in Life Science. 5(5):1755-1759.

Hanbury, C. D., C. L. White, B. P. Mullan and K. H. M. Siddique, 2000. A review of the potential of *Lathyrus sativus* L. and *L. cicero* L. grain for use as animal feed. Anim. Feed Sci. Technol. 87:1-27.

Keogh B. Mc., T. Grath and J. Grant, 2001. The effect of sowing date and nitrogen on the dry-matter yield and nitrogen content of forage rape (*Brassica napus* L.) and stubble turnips (*Brassica rapa* L).

Kumari A., R.P. Singh and Yeshpal, 2012. Productivity, nutrient uptake and economics of mustard hybrid (*Brassica juncea*) under different planting time and row spacing. Indian Journal of Agronomy.; 57(1):61-67.

Kushwaha C.L., K. Prasad and S.P. Kushwaha 2006. Effect of row spacing and nitrogen doses on yield attributes and yield of linseed (*Linum usitatissimum* L.) varieties under irrigated conditions of Bundelkhand. Plant Archives. 6(2):741-743.

Kushwaha C.L., K. Prasad and S. P. Kushwaha, 2006. Effect of row spacing and nitrogen doses on plant population and growth of linseed (*Linum usitatissimum* L.) Varieties. Plant Archives. 6(2):729-731.

Mahboob A., M.A. Chowdhury and A.E. Slinkard, 2000. Genetic diversity in grass pea *Lathyrus sativus* L. Genetic Resources and Crop Evolution. 47, 163-169.

Mahmood, H., S. TOWFIQ and K. Rashid, 2019. The sensitivity of different growth stages of sunflower (*Helianthus annuus* L.) Under deficit irrigation', applied ecology and environmental research, 17(4), pp. 7605-7623.

Maurya A.C., M. Raghuvveer, G. Goswami, S. Kumar, 2017. Influences of date of sowing on yield attributes and yield of linseed (*Linum usitatissimum* L.) varieties under dryland condition. International Journal of Current Microbiology and Applied Sciences; 6(7):481-487.
Piergiovanni A.R., F. Lupo and M. Zaccardelli, 2010. Environmental effect on yield, composition and technological seed traits of some Italian ecotypes of grass pea (*Lathyrus sativus* L.). Journal of Science, Food and Agriculture. 91, 122-129.

Polignano G.B., P. Uggenti, V. Bisignano and E..Alba, 2003. Patterns of variation in Lathyrus sativus and some related species. Mediterranean journal of Agriculture. 133, 81-88.

Arora R.K., P.N. Mathur, K.W. Riley and Y. Adham (Eds.), 1995. Lathyrus Genetic Resources in Asia: Proceedings of a Regional Workshop, December 27–29, Indira Gandhi Agricultural University, Raipur, India, pp. 45-52

Rao, S. C., 2008. Effects of Planting Date on Biomass Production by Grass pea (*Lathyrus sativus* L.).

Rao S. C., B. K., Northup and H. S., Mayeux, 2005. Candidate cool-season legumes for filling forage deficit periods in the southern Great Plains. Crop Sci. 45 2068–2074

Rao S. C., B. K. Northup, W. A. Phillips and H. S. Mayeux, 2007. Inter-seeding novel cool-season annual legumes to improve bermudagrass paddocks. Crop Sci. 47 168–173

Rehman, A.U., M. Amjad Ali, B.M. Atta, M. Saleem, A. Abbas and A. R. Mallahi, 2009. Genetic studies of yield related traits in mungbean (*Vigna radiata* L. Wilczek). Aust. J. Crop Sci., 3: 352-360.

Saoji B.V., M.J. Patil, M.K. Moon, V.Nagdeote and A. H. Khade, 2007. Effect of spacing and higher seed rates on yield of linseed in command area of Gondia district. Journal of Soils and Crops. 17(1):117–121.

Sharma, R.N., M.W. Chitale, G. B. Ganvir, A.K. Geda and R. L. Pandey, 2000. Observations on the development of selection criterion for high yield and low neurotoxin in grass pea based on genetic resources. Lathyrus Lathyris Newsletter 1.

Singh VP, M. Singh and DV. Singh, 1998. Growth, Yield and Quality of Peppermint (*Mentha x piperita* L).

Steel, R.G.D. and J. H. Torrie, 1986. Principles and procedures of statistics: A biometrical approach. Second Edition, McGraw Hill Co. Inc., New York.

Tomar, G.S., S.P.S Tomar, and S.N. Khajanji, 2011. Science of crop production: part– II. Kushal publications and distributors, Varanasi.

Zambre M., B. Chowdhury, Y.H. Kuo, M.V. Montagu, G. Angenon and F. Lambein, 2002. Prolific regeneration of fertile plants from green nodular callus induced from meristematic tissues in *Lathyrus sativus* L. (grass pea). Plant Science. 163, 1107-1112.
تأثر مواعيد الزراعة على النمو والحاصل ومكوناته لأصناف الهرطمان (Lathyrus Sativus) في منطقة السليمانية

جوان غريب رفعت، شاقي أدب غريب، سهير سردار حسن
قسم بابتكولوجو و المحاصيل الحقلية - كلية علوم الهندسة الزراعية - جامعة السليمانية – السليمانية. عراق

الخلاصة

نفذت تجربة حقلية في محافظة السليمانية بموقع قلياسان خلال الموسم الشتوي 2019-2020 وفق تصميم قطاعات العشوية الكاملة و بثلاث مكررات بتجربة عاملية حيث شمل العامل الأول ثلاث مواعيد زراعية وهي 15-تشرين الأول و الأول من تشرين الثاني و 15 تشرين الثاني اما العامل الثاني يشمل أربعة تراكيب وراثية من الهرطمان IF003، IF133، IF102، IF067. و لعرض تأثير مواعيد زراعة على صفات النمو و حاصل و مكوناته على التراكيب الوراثية المدرسة. وقد اظهرت نتائج IF067 عدم وجود فروق معنوية بين التراكيب الوراثية للصفات المدرسة، وان الموعد الأول قد سجل اقل عدد ايام للوصول الى 50% تزهير و النضج (159.567 يوم) واعلى معدل لعدد الحبوب في القرنة (4.333 حبة) و حاصل الحبوب (5599.141 كغم / هكتار) و دليل الحصاد (0.403 ٪) ، و ان الموعد الثالث فقد أعطي أعلى معدل لارتفاع النباتات (91.391 كسم) والحاصيل البابتكولوجي (18004.514 كغم/ هكتار).

الكلمات المفتاحية: الهرطمان، الأصناف، مواعيد الزراعة، الحاصل، مكونات الحاصل