



IRAQI
Academic Scientific Journals



العراقية
المجلات الأكاديمية العلمية

TJAS

Tikrit Journal for
Agricultural
Sciences

ISSN:1813-1646 (Print); 2664-0597 (Online)

Tikrit Journal for Agricultural Sciences

Journal Homepage: <http://tujas.tu.edu.iq>

E-mail: tjas@tu.edu.iq

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KEY WORDS:

Grass pea, sowing date,
growth, yield components.

ARTICLE HISTORY:

Received: 17/01/2021

Accepted: 23/02/2021

Available online: 31/03/2021

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 (59.391cm), 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).

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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

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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 N₂ 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, *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 (*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°C and often reaching nearly 50°C. October has temperature ranged from 24-29°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 15th (S1), 1st November (S2), and 15th 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 3m², 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 leave 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.

Table (1): Mean Squares of variance for growth of forage yield components of grass pea

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 (S)	2	739.389**	4.454 n.s	3872.502**	654.996**	1.232 n.s	0.281 n.s	0.316 n.s
Varieties (V)	3	8.627 n.s	1.849 n.s	3.245 n.s	23.199 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

Table (2): Mean Squares of seed yield and its components of grass pea

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 (S)	2	136.861**	9.694**	4.440 n.s	7756312.782**	133318947.099*	0.082**
Varieties (V)	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 ($p \leq 0.05$)	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 ($p \leq 0.05$)	6.447 **	1.100n.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	4227.86	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

No of pods plant⁻¹

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 confirm 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 **

No. of seeds pod⁻¹

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 ^{ns}	2.201 ^{ns}	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.

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الخلاصة

تأثير مواعيد الزراعة على النمو والحاصل ومكوناته لأصناف الهرطمان (*Lathyrus Sativus*) تحت ظروف الزراعة الديمية في منطقة السليمانية

جوان غريب رفعت ، شايي اديب غريب ، سه يران سردار حسن

قسم بايو تكنولوجي و المحاصيل الحقلية - كلية علوم الهندسة الزراعية - جامعة السليمانية - السليمانية - عراق

نفذت تجربة حقلية في محافظة السليمانية بموقع قلياسان خلال الموسم الشتوي 2019-2020 وفق تصميم قطاعات العشوائية الكاملة و بثلاث مكررات بتجربة عاملية حيث شمل العامل الاول ثلاث مواعيد زراعية وهي 15-تشرين الاول و الاول من تشرين الثاني و 15 تشرين الثاني اما العامل الثاني تشمل اربعة تراكيب وراثية من الهرطمان IF003 ، IF133 ، IF102 و IF067 لغرض تأثير مواعيد زراعة على صفات النمو و حاصل ومكوناته على التراكيب الوراثية المدروسة. و قد اظهرت نتائج عدم وجود فروق معنوية بين التراكيب الوراثية للصفات المدروسة، وان الموعد الاول قد سجل اقل عدد ايام للوصول الى 50٪ تزهير و النضج (92.819، 159.567 يوم) و اعلى معدل لعدد الحبوب في القرنة (4.333 حبة) و حاصل الحبوب (5599.141 كغم / هكتار) في حين تفوق الموعد الثاني في عدد القرنت للنبات (27.417) ودليل الحصاد (0.403 ٪)، وان الموعد الثالث فقد اعطى اعلى معدل للارتفاع النبات (59.391 سم) والحاصل البيولوجي (18004.514 كغ/هكتار) .

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