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Determination of radiation use efficiency (RUE) of grass pea under different sowing dates

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Abstract

A field experiment was carried out to determine radiation use efficiency (RUE) of grass pea at Instructional Farm, Bidhan Chandra Krishi Viswavidyalaya, West Bengal during rabi season of 2016-2017. Grass pea (Variety: 'Prateek') was sown on nine different dates from 26th October to 21st December at weekly interval. Sun shine hours accumulated during pre-flowering, post-flowering phases and entire growing period was calculated. Solar radiation accumulated during the growing period of the crop was computed by using SSH values. Dry matter yields (biological yield excluding grain yield) was recorded and statistically analyzed. Radiation use efficiency (RUE) was calculated. 26th October sown crop experienced highest solar radiation (2948.86mjm-2) and lowest solar radiation (2341.67mjm-2) was experienced by the crop sown on 21st December. The crops sown on 16th November produced maximum dry matter (3838.5kg/ha) while lowest dry matter (1903.1kg/ha) was obtained from 21st December sown crop. RUE value was the highest (1.451) in 16th November sown crop and lowest (0.813) in 21st December sown crop.

Keywords: Dates of sowing, dry matter, grass pea, radiation use efficiency, sun shine hours

Introduction

Grass pea (*Lathyrus sativus* L.), one of the most important pulse crops, is cultivated during winter season in India. It is a drought tolerant hardy crop. It has the ability to grown in a wide range of climate and soil (Campbell *et al*., 1994) [2]. The seeds of grass pea are hardy and can be stored for more than two years without appreciable loss in germinability and vigour. Grass pea has great potential as a fodder crop. The young plants are used as a fodder for cattle or for grazing. Normally, the fields are allowed to be strip-grazed by cattle before the crop is allowed to regrow and then harvested for seed. Grass pea seeds are used as a complementary or sole source of calories and proteins, mostly by the poor farmers and landless labourers. Seed yields increase with the increase in the dry matter production at maturity. Improvement in seed yield of grass pea is likely to come from management practices that increase dry matter production. The plants are normally pulled while they are still green but after the pods have filled. This allows maximum food value to remain in the biomass and at the same time produces good seed yields. In India, grass pea is mainly grown in rainfed ecosystem and climate determines seed yield and dry matter production of grass pea. Dry matter production is greatly influenced by solar radiation to which the crop is exposed during its growing period. Radiation use efficiency (RUE) indicates the amount of biomass per unit intercepted solar radiation (Sinclair *et al*., 1989) [5] varies as the sowing time varies. Thus a field experiment was conducted to determine RUE of grass pea sown on different dates.

Materials and methods

In order to investigate the radiation use efficiencies (RUE) of grass pea as affected by different dates of sowing, one field experiment was conducted in Randomized Complete Block Design (RCBD) with nine treatments (nine dates of sowing: from 26th October to 21st December at weekly interval) and three replications at Instructional Farm (22°58´ N and 88°31´ E), Bidhan Chandra Krishi Viswavidyalaya, West Bengal during rabi season of 2016-2017. Name of the variety was 'Prateek'. Line sowing method was followed with a seed rate of 40 kg/ha. The crop was provided with recommended dose of fertilizers as basal and two live saving irrigations. No pest or disease attack was observed. Solar radiation accumulated during pre-flowering, post-flowering and entire growing period and radiation use efficiencies (RUE) were computed by using the formula used by Ratnam *et al*. (2016),

Solar radiation= SSH X 3.66 (mjm^{-2})

Radiation use efficiency= Dry matter yield ÷ Solar radiation

Where, SSH = sun shine hours obtained from principal agrometeorological observatory; unit of RUE is g mj^{-1} (Kaushik *et al*., 2015) [3]

Dry matter indicated the biological yield of the crop excluding grain yield.

Results and discussions

Agroclimatic environment during growing season: Agroclimatic environment during the entire growing period of grass pea has been represented in table 1. Maximum air temperature (T_{max}) showed a decreasing trend from 43rd Standard Meteorological Week (SMW) to 2nd SMW and then it started to increase up to the end of the growing period. Highest T_{max} (34.3°C) was observed in 13th SMW while T_{max} was the lowest (23.8°C) during 2nd SMW. Both minimum temperature (T_{min}) and mean temperature (T_{mean}) were highest during 14th SMW. Lowest T_{min} (6.2°C) was observed during 3rd SMW on the other hand T_{mean} was found to be lowest (15.9°C) during both 2nd and 3rd SMW. The crop experienced no rainfall beyond 45th SMW. Morning relative humidity (RH I), afternoon relative humidity (RH II) and mean relative humidity (RH_{mean}) during the growing season of grass pea has been presented in table 1.

Accumulated sun shine hours (SSH): Sun shine hours (SSH) accumulated during pre-flowering, post-flowering and entire growing period has been shown in table 2. During pre-flowering phase accumulated SSH varied from its lowest value (278.9 hours) in the crop sown on 26th October to the highest value (354.4 hours) that was obtained from the crop sown on 2nd November. In case of post-flowering phase, accumulated SSH was the highest (526.8 hours) in 26th October sown crop whereas lowest SSH (333.5 hours) was accumulated in the crop that was sown on 21st December. SSH showed clear decreasing trend during post-flowering phase, from 26th October sown crop to 21st December sown crop. Results revealed that early sown crops experienced higher SSH as compared to late sown crops.

Accumulated solar radiation: Table 3 shows the accumulated solar radiation during pre-flowering, post-flowering phases and entire growing period. The crops sown on 26th October experienced highest accumulated solar radiation (2948.86mjm^{-2}) and lowest solar radiation (2341.67mjm^{-2}) was accumulated in the crop sown on 21st December. Accumulated solar radiation also showed decreasing trend from 26th October sown crop to 21st December sown crop.

Dry matter yield: Table 4 represents the effect of dates of sowing on dry matter production of grass pea. It is evident from the result that dry matter production of grass pea varied from 1903.1kg/ha in 21st December sown crop to 3838.5kg/ha in 16th November sown crop. There were significant differences in dry matter produced under different dates of sowing. The highest dry matter yield (3838.5kg/ha) of grass pea was observed in crop sown on 16th November which was statistically at par with the dry matter produced from the crops sown on 26th October, 2nd November, 9th November and 23rd November. There was significant reduction in dry matter production in crops sown after 23rd November. Thus it is observed that crop sown during the period from 26th October to 23rd November gave rise to biomass to the tune of above 3000kg/ha while the crops sown after 23rd November (30th November, 7th, 14th and 21st December) produced dry matter ranging from 1903.1kg/ha to 2331.0kg/ha. The results further revealed that for every seven days delay in sowing beyond 16th November there were reductions in dry matter production by 13.3%, 39.3%, 46.2%, 48.5% and 50.4% in crops sown on 23rd November, 7th December, 14th December and 21st December, respectively. Thus it is evident that crop sown beyond 23rd November were vulnerable to produce lesser dry matter than the crop sown on 16th November. Bishnoi *et al*. (1994) reported in that dry matter production in pegion pea reduced with delay in the sowing dates.

Radiation use efficiency (RUE): Table 5 shows radiation use efficiency of the crop under different dates of sowing. Highest RUE (0.145) was found in the crops sown 16th November while the crop sown on 21st December showed lowest RUE (0.081). Results indicated significant reduction in RUE when the crop was sown beyond 16th November. Decrease in RUE with delay in sowing dates was demonstrated earlier in pigeon pea by Patel *et al*. (2000) [4]. Kaushik *et al*. (2015) [3] reported that radiation use efficiency of soybean decreased as the sowing dates advanced.

Conclusions

From the research it may be concluded that the crops sown on different times experienced a wide range of varying weather conditions. SSH and solar radiation accumulated during the entire growing period of the crop decreased as the sowing time advanced. Delay in sowing time resulted in reduction in the dry matter production. RUE was significantly influenced by the sowing time. Crops sown on later dates showed lesser values of RUE.

Table 1: Weekly Agroclimatic environment during growing season of grass pea

Standard Meteorological Week (SMW)	Maximum temperature (˚C)	Minimum temperature (˚C)	Mean temperature (˚C)	Sun shine hours	Total rainfall (mm)	RH I (%)	RH II (%)	RH mean (%)	Solar radiation (mjm^{-2})
43	31.2	20.4	25.8	5.2	71.2	95.3	68.4	81.9	19
44	30.0	21.2	25.6	5.0	10.9	94.3	75.6	85.0	18.3
45	29.6	12.7	21.2	7.4	6.2	93.7	58.3	76.0	27.1
46	25.6	13.7	19.6	8.4	0.0	85.9	46.0	65.9	30.7
47	28.6	13.2	20.9	5.9	0.0	96.0	56.9	76.4	21.6
48	28.9	14.4	21.7	6.2	0.0	92.6	57.9	75.2	22.7
49	27.6	11.8	19.7	7.6	0.0	95.7	54.1	74.9	27.8
50	24.8	8.6	16.7	6.9	0.0	95.4	58.0	76.7	25.3
51	26.0	10.4	18.2	3.7	0.0	95.7	53.0	74.4	13.5
52	25.4	11.2	18.3	4.1	0.0	99.4	65.4	82.4	15
1	25.2	10.0	17.6	5.8	0.0	98.6	52.4	75.5	21.2
2	23.8	8.0	15.9	6.5	0.0	95.7	44.0	69.9	23.8
3	25.5	6.2	15.9	8.3	0.0	95.0	39.1	67.1	30.4
4	26.8	9.6	18.2	7.2	0.0	96.4	47.9	72.1	26.4
5	26.1	9.7	17.9	7.5	0.0	96.9	56.0	76.4	27.5

6	29.0	11.2	20.1	8.2	0.0	92.4	40.4	66.4	30
7	29.6	13.3	21.4	4.8	0.0	95.4	43.3	69.4	17.6
8	31.0	15.5	23.3	5.6	0.0	89.4	41.0	65.2	20.5
9	32.6	13.7	23.2	8.4	0.0	88.3	32.1	60.2	30.7
10	30.7	17.4	24.0	3.3	1.3	92.7	58.1	75.4	12.1
11	31.2	14.1	22.7	8.4	0.0	87.1	36.1	61.6	30.7
12	33.1	18.2	25.7	7.6	2.1	95.3	49.3	72.3	27.8
13	34.3	22.8	28.6	6.6	3.2	94.0	60.1	77.1	24.2
14	34.0	23.5	28.8	4.8	1.8	97.7	63.7	80.7	17.6

Table 2: Accumulated sun shine hours (SSH) during growing period of grass pea

Dates of sowing	Pre-flowering phase	Post-flowering phase	Entire growth phase
26th October	278.9	526.8	805.7
2nd November	308.0	491.2	799.2
9th November	287.2	486.0	773.2
16th November	286.2	436.5	722.7
23rd November	354.4	383.9	738.3
30th November	341.0	368.0	709.0
7th December	310.9	365.9	676.8
14th December	296.6	353.3	649.9
21st December	306.3	333.5	639.8
Mean	307.7	416.1	723.8
S.D. (±)	25.340	70.564	61.227
C.V. (%)	8.23	16.96	8.46

Table 3: Accumulated solar radiation (mjm^{-2}) during growing period of grass pea

Dates of sowing	Pre-flowering phase	Post-flowering phase	Entire growth phase
26th October	1020.77	1928.09	2948.86
2nd November	1127.28	1797.79	2925.07
9th November	1051.15	1778.76	2829.91
16th November	1047.49	1597.59	2645.08
23rd November	1297.10	1405.07	2702.18
30th November	1248.06	1346.88	2594.94
7th December	1137.89	1339.19	2477.09
14th December	1085.56	1293.08	2378.63
21st December	1121.06	1220.61	2341.67
Mean	1126.26	1523.01	2649.27
S.D. (±)	92.747	258.263	224.090
C.V. (%)	8.23	16.96	8.46

Table 3: Variation in dry matter production (kg/ha) as affected by varied dates of sowing

Dates of sowing	Dry matter production (kg/ha)
26th October	3372.1
2nd November	3496.5
9th November	3761.6
16th November	3838.5
23rd November	3326.3
30th November	2331.0
7th December	2065.1
14th December	1977.7
21st December	1903.1
C.D. (5%)	954.4
SEm (±)	315.631
C.V. (%)	18.87

Table 4: Radiation use efficiency (RUE) as affected by varied dates of sowing

Dates of sowing	Radiation use efficiency (g mj^{-1})
26th October	0.114
2nd November	0.119
9th November	0.133
16th November	0.145
23rd November	0.123
30th November	0.089
7th December	0.083
14th December	0.083
21st December	0.081

References

1. Bishnoi OP, Niwas R, Taneja KD, Rao VUM. Effect of weather parameters on biomass production in pegion pea. Annals of Arid Zone. 1994; 32(2):117-11
2. Campbell CG, Mehra RB, Agrawal SK, Chen YZ, El Ali AMA, Khawaja HIT *et al*. Current status and future strategy in breeding grass pea (*Lathyrus sativus*). Euphyt. 1994; 73:167-175.
3. Kaushik DK, Patel SR, Chandrawanshi SK, Khavse R, Chaudhary JL. Study on agrometeorological indices for soybean crop under different sowing dates in Chhattisgarh region of India. Indian J Agric. Res. 2015; 49(3):282-285
4. Patel NR, Mehta AN, Shekh AM. Radiation absorption, growth and yield of pigeonpea cultivars as influenced by sowing dates. Exp. Agric. 2000; 36:291-301.
5. Sinclair TR, Horie T. Leaf Nitrogen, photosynthesis and crop radiation use efficiency: A review. Crop Sci. 1989; 29:90-98