BIBLIOGRAPHY

BADAY, MELIO P. APRIL 2012. Yield Performance of F_1 Hybrid 'Dynasty' Spinach As Affected by Different Frequency and Volume of Irrigation. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

Performance of the F_1 Hybrid 'Dynasty' spinach affected by different frequency and volume of irrigation were evaluated in January to February 2012 at the Ornamental Horticulture experiment area, Benguet State University, La Trinidad Benguet. Economic analysis of the crop as affected by the treatments was also done.

Results reveal that there were no significant differences obtained from the application of treatment. However, highest return of investment was obtained by irrigation of 5/m2 irrigated every 6 days at 104.39%, implying a PhP 1.04 income per peso spent.

RESULTS AND DISCUSSION

Plant Height

Effect of volume of irrigation water. There were no significant differences obtained on the plant height as shown in Table 1.

According to MC Mahon, 2002 irrigation will frequently bring up the crop the more volume of water irrigated it accelerates growth of spinach.

Effect of frequency of irrigation. There were no significant differences obtained in the plant height as shown in Table 1. However, the more number of days interval results to shorter spinach.

According to Hansen *et. al*., (1980) an application of one inch of water every 3 to 5 days is already sufficient for normal growth of spinach.

Interaction effect. There were no significant interaction effects obtained between volume and frequency of irrigation on plant height (Table1).

Table 1. Plant height (cm) of spinach as affected by different frequency and volume of Irrigation

TREATMENTS	MEAN HEIGHT (cm)
Volume of irrigation (li/1.25m^2)	
5	17.11
10	17.47
15	17.53
Frequency of irrigation (Days interval)	
2	17.73
4	17.78
6	16.80

Means with common letters are not significant at 5% level by DMRT

Average Plant weight

Effect of volume of irrigation water. There were no significant differences obtained on the average plant weight as shown in Table 2.

Effect of frequency of irrigation. Differences obtained on the effect of day's interval on the average weight were not significant as shown in Table 2.

Interaction effect. There were no significant effects between the volume and frequency on the average plant weight (Table 2).

Table 2. Average plant weight (kg) of spinach as affected by different frequency and volume of irrigation

TREATMENTS	MEAN PLANT WEIGHT (kg)
Volume of irrigation (li/1.25m^2)	
5	5.82
10	5.56
15	5.62
Frequency of irrigation (Days interval)	
2	5.94
4	5.60
6	5.46

Means with common letter are not significant at 5% level by DMRT

Plant Canopy

Effect of volume of irrigation. There were no significant differences obtained on the canopy of plants irrigated at different volumes as shown in Table 3.

Effect of frequency of irrigation. Table 3 shows that there were no significant differences on the plant canopy of spinach as affected by the different frequency of irrigation.

Interaction effect. There were no significant differences noted on the effect of volume and frequency on the plant canopy.

Table 3. Plant canopy of spinach as affected by different frequency and volume of Irrigation

TREATMENT	MEAN PLANT CANOPY (%)
Volume of Irrigation (li/1.25m^2)	
5	78.17
10	74.92
15	78.73
Frequency of irrigation (Days interval)	
2	73.56
4	83.81
6	74.45

Means with common letter are not significant at 5% level by DMRT

Marketable Yield Per Plot

Effect of volume of irrigation. There were no significant differences obtained from the marketable yield as effected by volume of irrigation (Table 4).

According to Swader *et. al.*, (1975) Good yields of fresh market spinach are from 3175 to 6883.89 kg per acre or 280 to 600 baskets or crates per acre containing 9.07 to 11.34 kg each.

Effect of frequency of irrigation. There were no significant differences obtained from the marketable yield per plot as shown in Table 4.

Interaction effect. There were no significant differences noted on the effect of volume and frequency of irrigation on marketable yield per plot.

Table 4. Marketable yield per plot of spinach as affected by different frequency and volume of irrigation

TREATMENT	MEAN MRKETABLE YIELD (kg)
Volume of Irrigation (li/1.25m^2)	
5	0.19
10	0.17
15	0.20
Frequency of irrigation (Days interval)	
2	0.19
4	0.19
6	0.19

Means with common letter are not significant at 5 % level by DMRT

Non-marketable Yield Per Plot

Effect of volume of irrigation. There were no significant differences obtained from the non-marketable yield per plot as shown in Table 5.

Non-marketable yield were due to the incidence of cutworm during the seedling stage of the spinach. Damage is most severe when a large number of cutworm larvae are present at seedling emergence. Each larva can destroy up to 4 plants (Knott, 1967).

Effects of frequency of irrigation. There were no significant differences obtained from the non-marketable yield per plot as shown in Table 5.

Interaction effect. There were no significant effect obtained from plants effected by volume and frequency of irrigation on the non-marketable yield.

Table 5. Non-marketable yield per plot of spinach as affected by different frequency and volume of irrigation

TREATMENT	MEAN NON-MARKETABLE YIELD (kg)
Volume of Irrigation (li/1.25m^2)	
5	0.056
10	0.062
15	0.038
Frequency of irrigation (Days interval)	
2	0.063
4	0.041
6	0.051

Means with common letter are not significant at 5%level by DMRT

Total Yield Per Plot

Effect of volume of irrigation. There were no significant differences obtained from the total yield of spinach as affected by the volume of irrigation (Table 6).

Effect of frequency of irrigation. There were no significant differences obtained from the total yield of spinach as affected by the frequency of irrigation (Table 6).

Interaction effect. There were no significant interaction effects obtained between volume and frequency of irrigation on the total yield of spinach.

Table 6. Total yield per plot of spinach as affected by different frequency and volume of Irrigation

TREATMENT	MEAN TOTAL YIELD (kg)
Volume of Irrigation (li/1.25m^2)	
5	0.25
10	0.23
15	0.25
Frequency of irrigation (Days interval)	
2	0.26
4	0.24
6	0.34

Means with common letter are not significant at 5%level by DMRT

Cutworm and Moth Larvae Incidence

Effect of volume of irrigation. There were no significant differences obtained on the incidence of cutworm and moth larvae at treatment application (Table 7a) and at harvesting stage (Table 7b) as affected by volume of irrigation.

Effect of frequency of irrigation. Table 7a and 7b show no significant differences on the average plant weight as affected by frequency of irrigation at treatment application and at harvesting stage.

Interaction effect. There were no significant interaction effects obtained between volume and frequency of irrigation on the incidence of cutworm and moth larvae.

Table 7a. Cutworm and moth larvae incidence of spinach as affected by different frequency and volume of irrigation at treatment application.

TREATMENT	MEAN RATING	
	Cutworm	Moth larvae
Volume of Irrigation (li/1.25m^2)		
5	1.44	1.61
10	1.44	1.61
15	1.37	1.56
Frequency of irrigation (Days interval)		
2	1.37	1.79
4	1.44	1.50
6	1.44	1.50

Means with common letter are not significant at 5%level by DMRT

Scale	Description
1	No pest
2	1-25% of the plant affected
3	26-50% of the plant affected
4	51-75% of the plant affected
5	76-100% of the plant affected

Table 7b. Cutworm and moth larvae incidence of spinach as affected by different frequency and volume of irrigation at harvesting stage.

TREATMENT	MEAN RATING	
	Cutworm	Moth larvae
Volume of Irrigation (li/1.25m^2)		
5	1.44	1.61
10	1.44	1.61
15	1.37	1.56
Frequency of irrigation (Days interval)		
2	1.37	1.79
4	1.44	1.50
6	1.44	1.50

Means with common letter are not significant at 5%level by DMRT

Scale	Description
1	No pest
2	1-25% of the plant affected
3	26-50% of the plant affected
4	51-75% of the plant affected
5	76-100% of the plant affected

Computed Marketable Yield

Effect of volume of irrigation. Results show in Table 8 that there were no significant differences obtained from the computed marketable yield of spinach as affected by volume of irrigation.

Effect of frequency of irrigation. There were no significant differences were observed on the computed marketable yield of spinach as affected by frequency of irrigation.

Chapman and Carter (1975) stated that the amount of water use directly related to yield increases; total water used increase because more water is needed for increased plant growth within the limits of available moisture and others.

Interaction effect. There were no significant differences obtained from the volume and frequency of irrigation on the computed marketable yield of spinach (Table 8).

Table 8. Computed marketable yield (t/ha) of spinach as affected by different frequency and volume of irrigation.

TREATMENT	MEAN COMPUTED MARKETABLE YIELD (t/ha)
Volume of Irrigation (li/1.25m^2)	
5	0.75
10	0.69
15	0.81
Frequency of irrigation (Days interval)	
2	0.77
4	0.75
6	0.74

Means with common letter are not significant at 5% level by DMRT

Initial and Final Moisture Content

Effect of volume of irrigation. Results show that there were no significant differences obtained on the initial and final moisture content as affected by the volume of irrigation (Table 9).

Effect of frequency of irrigation. There were no significant differences obtained on the initial and final moisture content as affected by frequency of irrigation shown (Table 9).

Interaction effect. There were no significant differences obtained between volume and frequency of irrigation on the initial and final moisture content as shown in Table 9.

Table 9. Initial moisture content (%) of spinach as affected by different frequency and volume of irrigation.

TREATMENT	MEAN MOISTURE CONTENT (%)	
	Initial	Final
Volume of Irrigation (li/1.25m^2)		
5	83.72	71.67
10	83.33	72.03
15	83.37	72.67
Frequency of irrigation (Days interval)		
2	84.76	74.84
4	84.61	71.72
6	81.06	69.94

Means with common letters are not significant at 5% level by DMRT

Soil Analysis

Table 10 shows the soil analysis before and after the study. The soil pH decreased slightly from 6.22 to 5.79 before and after the study, respectively. On the other hand, organic matter decreased from 3.0 to 2.5 %, phosphorous decreased from 49 to 45 ppm, and potassium decreased from 230 to 186 ppm.

Table 10. Soil Analysis of the experimental area before and after the study.

	Ph	OM%	P, ppm	K, ppm
Before	6.22	3.0	49	230
After	5.79	2.5	45	186

Economic Analysis

Return on Cash Expense

Effect of volume of irrigation. Table 11a shows that there were no significant differences on the return on cash expense (ROCE) were obtained from plants grown in different volume of irrigation. Numerical values show that plants irrigated at a rate of 5 li/1.25m^2 obtained the highest ROCE at 83.61%. This implies that for every peso spent, 83.61centavos is realized as an income.

Effect of frequency of irrigation. There were no significant differences on the return on cash expense (ROCE) obtained from plants grown in different frequency of irrigation as shown in Table 11a. Numerical values show that plants irrigated every 6 days obtained the highest ROCE at 85.95%. This implies that for every peso spent, 89.95 centavos is realized as an income.

Interaction effect. There were no significant differences obtained between volume and frequency of irrigation on the return on cash expense as shown in Table 11b. Numerical values show that plants irrigated at 5 li/1.25m2 every 6 days obtained the highest ROCE at 104.39%. This implies that for every peso spent, PhP1.04 is realized as an income.

Table 11. Return On cash expense (ROCE) from spinach production (100 m^2 area) as affected by volume and frequency of irrigation

TREATMENT	TOTAL MARKETABLE YIELD (Kg)	GROSS INCOME (PhP)	PRODUCTION COST (PhP)	NET INCOME (PhP)	ROCE (%)
Volume of irrigation (li/1.25m^2)					
5	15.02	1805.67	982.98	819.98	83.61
10	13.84	1644.00	1039.97	624.03	61.52
15	14.45	1952.00	1097.25	853.42	78.53
Frequency of irrigation (Days interval)					
2	15.38	1845.33	1147.25	696.75	61.37
4	15.02	17 92.00	1013.15	778.85	76.38
6	14.90	1781.33	959.51	821.82	85.95

Table 11b. Return on cash expense from spinach production as affected by the treatment combination of volume and frequency of irrigation

Volume of irrigation (li/1.25m2)	5			10			15		
Frequency of irrigation (Days interval)	2	4	6	2	4	6	2	4	6
Gross Income									
Computed marketable Yield	0.21	0.16	0.20	0.16	0.19	0.17	0.21	0.21	0.19
@ ₱120.00/kg	**24.80**	**19.20**	**23.60**	**18.80**	**22.80**	**20.80**	**25.60**	**25.20**	**22.40**
Projected Yield (100 sq.m)	**1,984.00**	**1,536.00**	**1,888.00**	**1,504.00**	**1,824.00**	**1,664.00**	**2,048.00**	**2,016.00**	**1,792.00**
Production Cost									
Seeds @ ₱0.9/g X 60g	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00
Water @ ₱0.0179/L	85.92	50.12	35.80	171.84	100.24	71.60	257.76	150.36	107.40
Farm Labor	868.41	805.91	780.91	868.41	805.91	780.91	868.41	805.91	780.91
Pencil, ballpen, pentel pen, recordbook, and plastic bags	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00
Subtotal	**1,061.33**	**963.03**	**923.71**	**1,147.25**	**1,013.15**	**959.51**	**1,233.17**	**1,063.27**	**995.31**
Net Income	**922.67**	**572.97**	**964.29**	**356.75**	**810.85**	**704.49**	**814.83**	**952.73**	**796.69**
ROCE	86.94	59.50	104.39	31.10	80.03	73.42	66.08	89.60	80.04
RANK	**3**	**8**	**1**	**9**	**5**	**6**	**7**	**2**	**4**

Meteorological data

Table 12 shows the meteorological data from January to February 2012 which was taken at the BSU- PAS-ASA station. During the conduct of the experiment, rainfall averaged 1.84mm; relative humidity averaged at 85.71 %; mean sunshine duration was 270.22 minutes; maximum and minimum temperatures from Pag-asa Station were 24.58^{0}C and 13.3^{0}C, respectively; and tunnel temperature averaged 23.97 ^{0}C.

According Lloyd (1935) spinach grows well in an environment with a relative humidity of 80-90 % with an optimum temperature of 16-18C. However if grown in high temperature and especially long days causes spinach to bolt thus destroying its market value.

Table 12. Average meteorological data and tunnel temperature taken from the PAG-ASA station at Balili, La Trinidad, Benguet and Ornamental Horticulture experimental area, respectively.

Month	Rainfall (mm)	Relative humidity (%)	Temperature C^0 Maximum	Minimum	Tunnel temperature C^0	Sun Shine Duration (Minutes)
January	1.4	86.63	24.13	13.1	23.48	296.95
February	3.4	86.6	23.9	10.7	24.45	286
Mean	1.84	85.71	24.58	13.3	23.97	270.22

Figure 1. Overview of the experimental field

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Ornamental Horticulture experimental area, Benguet State University, La Trinidad Benguet from January to February 2012 to evaluate the effect of volume and frequency of irrigation on the growth of spinach, determine the best volume and frequency of irrigation for spinach production and to determine the economics of applying the different treatment for spinach production.

Results reveal that there were no significant differences obtained from the application of the different treatments. However, highest return on cash expense was obtained by irrigation 5 li/1.25m^2 every 6 days at 104.39%

Conclusion

It is therefore concluded that irrigation in spinach be done at 5 li/1.25m^2 every six days to obtain higher return on cash expense.

Recommendation

Based on the results of this irrigation study, water at 5 li/1.25m^2 applied every six days is desired for spinach.

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