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Productivity of Sugarcane High Yielding Varieties Planted at Different Furrow Spacing

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Abstract:
The study was conducted to evaluate the productivity of new high yielding varieties planted at different furrow spacing under Isabela condition. It was conducted at the Central Experiment Station of the Isabela State University at Cabagan Campus from August 2017 to December 2018. A total of 3,060 sq. m. area was used in the study. The experiment was laid-out following the Randomized Complete Block Design (RCBD) in two factorial experiment with the following treatments replicated three times: Three varieties namely V1- VMC 84-524 (Control); V2- Phil 99-1793; V3- Phil 2000-2569; and four furrow spacing such as B1- 1.20 meter (Control); B2- 1.40 meter; B3- 1.60 meter and B4 - 0.50 m x 1.20 m. Result of the study revealed that Phil 2000-2569 (V3) planted at 0.50 x 1.20 m significantly produced the highest cane yield while VMC 84-524 (V1) and Phil 2000-2569 (V3) gained highest income when planted at 1.60 m.

Keywords: *sugarcane productivity, sugarcane HYV, furrow spacing, dual row spacing*

I. INTRODUCTION

The sugarcane industry contributed about P87 billion to the Philippine economy in Crop Year 2013-14 from the sales of raw sugar, molasses and bioethanol, from tolling fees on sugar refining and Value Added Tax on refined sugar. In addition, it brought in US$ 111.76 million through exports of sugar to the US and world markets. Moreover, the displacement of gasoline with 10% bioethanol derived from sugarcane and molasses also generates savings of foreign currency reserves apart from contributing towards a cleaner and greener environment (SRA Roadmap, 2020). The Cagayan Mill District which include some part of Isabela and Kalinga has contributed only a very small fraction (only about 0.6% of the total sugarcane production) of this income due to the measly sugarcane area compared to other sugarcane producing regions in the country. Moreover, Region 2 has the lowest yield of 30-42 TC/ha only, way below the production rate of Negros which is 75 TC/ha. According to authorities, the main reason for the very low cane yield is the continuously deteriorating sugarcane variety that is repeatedly planted by farmers and the application of inappropriate production practices.

Due to increasing demand for sugar, there is a need for expanding cane areas and, mechanization plays a very important roleinorder to increase productivity. However, mechanizing cane farms in the Philippines is quite difficult to do especially with the use of large tractors as most cane farmers conventionally grow canes at 80 cm

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row spacing and even closer that can not permit plowing and hoeing with tractor. Effect of wider row spacing therefore needs to be evaluated to determine the best spacing for mechanized farming.

New sugarcane varieties specifically high yielding varieties are needed in Isabela and nearby province of Cagayan due to newly developed sugarcane plantations. The use of high yielding varieties is proven not only to increases cane tonnage per hectare but also enhances sugar production. Since yield potential of varieties at hand is continuously due to segregation, susceptibility to diseases, insect's admixture and changes in edaphic and climatic environments, it is essential to select the varieties with high yield potential and wide range of adaptability. Planting pattern is also a key component of sugarcane production because it is the primary determinant of plant density of the crop. The need to test the productivity of new varieties under Isabela condition is therefore necessary, hence this study.

Objectives of the Study

In general, this study aimed to determine the effect of different furrow spacing on the growth and yield of select sugarcane high yielding varieties.Specifically, it is aimed to:

1. evaluate the growth and yield performance of new sugarcane high yielding varieties planted at different furrow spacing under Isabela condition; and
2. do a simple profitability analysis of the different treatment.

II. METHODOLOGY

The study was conducted at the Central Experiment Station of the Isabela State University at Cabagan Campus from August 2017 to December 2018. The experimental site has a slightly sloping area which has been previously planted with various upland crops like peanut, sweet potato, and some forage legumes. The soil in the area is sandy clay loam and well drained with pH level of 5.7.

A total of 3,060 sq. m. area was used in the study. The whole area was divided into three equal block with, each block was divided into 12 plots measuring 5 m x 6 m. The experiment was laid-out following the Randomized Complete Block Design (RCBD) in two factorial experiment with the following treatments replicated three times:

Factor A (Varieties)
Factor B (Furrow Spacing)
V1- VMC 84-524 (Control)
B1- 1.20 meter (Control)
V2- Phil 99-1793
B2- 1.40 meter
V3- Phil 2000-2569
B3- 1.60 meter

B4 - 0.50 m x 1.20 m

Volume of fertilizer and timing of application were based on the result of the soil analysis conducted prior to the establishment of the study. The crops were irrigated using water pumps as needed. To protect the canes from weeds and pests and diseases, appropriate herbicide, insecticide and fungicide were applied as needed. All cultural management practices were applied uniformly to all the treatment following the technologies recommended by the Sugar Regulatory Administration.

III. RESULT AND DISCUSSIONS

Monthly Plant Height

Table 1 shows the varietal response on monthly plant height from 5 months after planting (MAP) to 12 MAP. As shown in the table, V2 (Phil 99-1793) and V3 (Phil 2000-2569) attained almost the same height from 5 MAP to 12 MAP. However, result of the analysis of variance revealed that only during the 5MAP, 6 MAP and 7

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MAP were found the heights to be significantly different with V3 exhibiting significantly taller heights compared to V1 (VMC 84-524). There is no significant difference on plant height for the rest of the months of the varieties tested.

Table 1. Varietal response on monthly plant height, cm

Variety	5 MAP	6 MAP	7 MAP	8 MAP	9 MAP	10MAP	11 MAP	12 MAP
V1 (VMC 84-524)	63.73[b]	88.65[b]	104.73[b]	120.92	141.04	158.04	214.27	243.52
V2 (Phil 99-1793)	71.75[ab]	97.0[ab]	113.25[a]	128.18	147.90	164.98	217.70	249.39
V3 (Phil 2000-2569)	73.58[a]	98.91[a]	115.08[a]	123.8	142.26	159.42	220.68	249.23
ANOVA	**	**	*	ns	ns	ns	ns	ns

As presented in Table 2, which is the effect of furrow spacing on plant height, only in 11 MAP and 12 MAP where significant differences were found as revealed by the result of the analysis of variance. Moreover, DMRT analysis shows that B3 (1.6 m furrow spacing) significantly produced taller sugarcane in the 11 MAP while in the 12 MAP, B2 (1.40 m), B3 (1.60 m) and B4 (0.50 x 1.20 m)are significantly different compared to B1.

Table 2. Effect of furrow spacing on monthly plant height, cm

Furrow Spacing	5 MAP	6 MAP	7 MAP	8 MAP	9 MAP	10 MAP	11 MAP	12 MAP
B1(1.20 m)	68.38	94.04	110.71	123.42	144.49	161.71	210.60[b]	238.49[b]
B2 (1.40 m)	48.94	67.69	79.78	89.79	104.78	117.36	218.87[ab]	251.98[a]
B3 (1.60 m)	72.58	97.35	113.58	125.49	145.69	163.13	227.18[a]	251.67[a]
B4 (0.50x1.20m)	72.54	97.76	113.44	128.56	145.05	161.94	213.56[b]	247.59[a]
ANOVA	ns	ns	ns	ns	ns	ns	**	**

Interaction effect of variety and furrow spacing on monthly plant height (Table 3) is not significant as revealed by the result of the analysis of variance.

Table 3. Interaction effect of variety and furrow spacing on monthly plant height, cm

Treatment No.	Variety	Furrow Spacing	5 MAP	6 MAP	7 MAP	8 MAP	9 MAP	10 MAP	11 MAP	12 MAP
T1	V1 (VMC 84-524)	B1 - 1.20 m	61.63	87.30	104.30	121.83	141.80	159.13	209.97	234.30
T2		B2 - 1.40 m	63.50	87.50	103.50	117.84	136.83	154.17	217.50	250.17
T3		B3 - 1.60 m	66.93	91.93	107.60	122.29	141.93	158.93	223.00	246.33
T4		B4 – 0.50x1.20 m	62.87	87.87	103.53	121.71	143.60	159.93	206.60	243.27
T5	V2 (Phil 99-1793)	B1 - 1.20 m	70.93	96.93	113.27	126.67	146.93	163.60	208.27	241.27
T6		B2 - 1.40 m	68.07	93.73	110.07	122.75	141.07	157.07	219.90	252.90
T7		B3 - 1.60 m	78.30	102.63	119.30	133.62	153.97	171.97	229.40	255.20
T8		B4 – 0.50x1.20 m	69.70	94.70	110.37	129.69	149.63	167.30	213.23	248.20
T9	V3 (Phil 2000-2569)	B1 - 1.20 m	72.57	97.90	114.57	121.76	144.73	162.40	213.57	239.90
T10		B2 - 1.40 m	64.20	89.53	105.53	118.57	141.20	158.20	219.20	252.87
T11		B3 - 1.60 m	72.50	97.50	113.83	120.56	141.17	158.50	229.13	253.47
T12		B4 – 0.50x1.20 m	85.05	110.72	126.38	134.29	141.93	158.60	220.83	250.70
ANOVA			ns	ns	ns	ns	ns	ns	ns	ns

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Number of Millable and Non-Millable Stalks

As shown in Figure 1, V3 produced the highest number of millable stalks with 77.59 followed by V2 with 74.34 and V1 with 70.79. In terms of the number of non-millable stalks, V1 produced the highest with 84.02 followed by V3 with 74.92 and V3 with 70.73. analysis of variance, however, revealed that there is no significant difference on both the number of millable and non-millable stalks as affected by varietal differences.

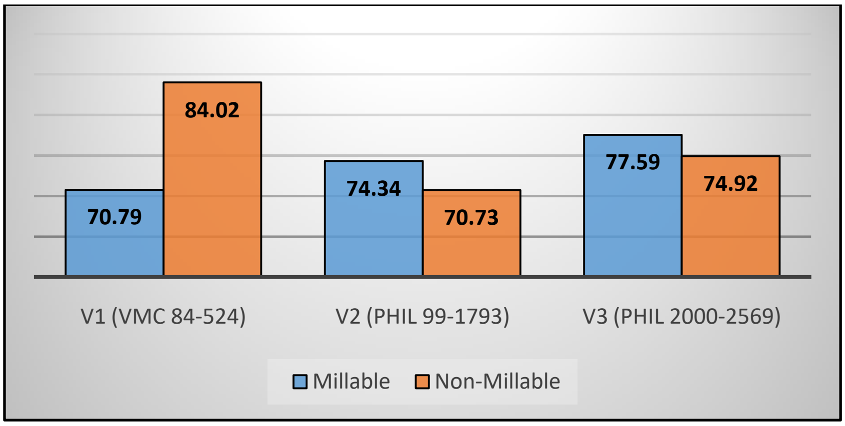

Figure 1. Varietal response to number of millable and non-millable stalks

Figure 2 on the other hand revealed that B4 produced the highest number of millable stalks of 80.94 while B1 produced the highest number of non-millable stalks of 88.20. Moreover, the result of the analysis of variance shows that the effect of the different furrow spacing on the number of millable and non-millablestalks is significant.

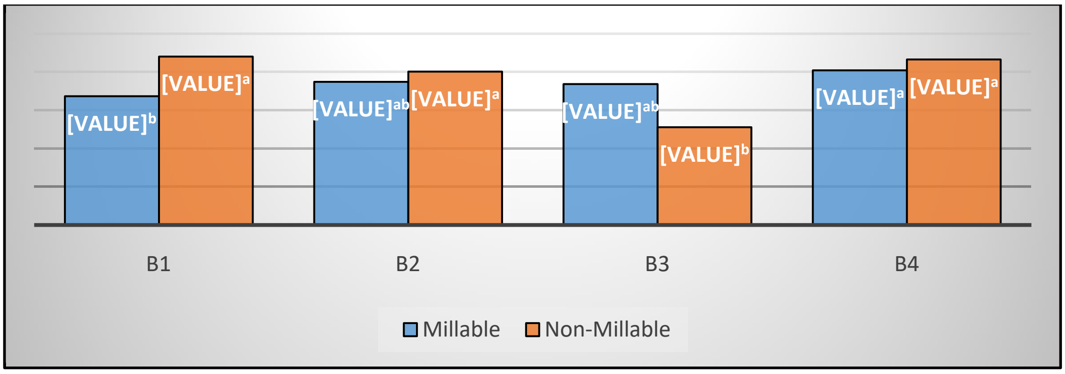

Figure 2. Effect of furrow spacing on number of millable and non-millable stalks

Table 4 presents the interaction effect of variety and furrow spacing on the number of millable and non-millable stalks. As presented in the table, only in the number of millable stalks where the effect is significant with T12 producing the highest millable stalks of 89.33. Differences in the number of non-millable stalks as affected by the different treatment is insignificant.

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Table 4. Interaction effect of variety and furrow spacing to number of millable and non-millable stalks

Treatment Number	Millable Stalks	Non-Millable Stalk
T1	65.67[d]	95.73
T2	68.33[cd]	92.93
T3	70.67[cd]	69.43
T4	78.50[abcd]	88.00
T5	66.00[d]	81.60
T6	85.67 [ab]	67.43
T7	70.67[cd]	66.50
T8	75.00[bcd]	87.38
T9	70.67[cd]	87.27
T10	70.67[cd]	80.47
T11	79.67[abc]	67.70
T12	89.33[a]	84.25
ANOVA	*	ns

Stalk Weight

As shown in Figure 3, V3 produced the heaviest stalk weight of 1.11 kg followed by V2 with 1.09 and V1 with 1.0. Result of the analysis of variance revealed that the differences in stalk weight is significant with V3 significantly heavier than V1.

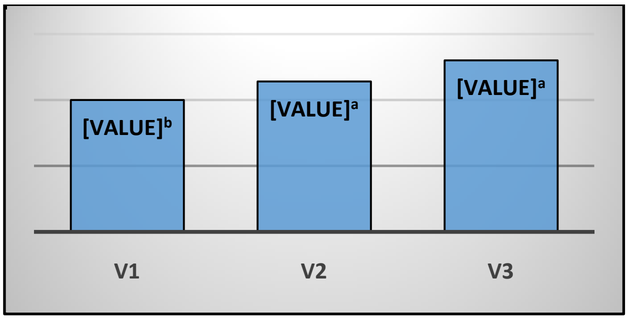

Figure 3.Varietal responseon stalk weight (kg)

Figure 4 shows that B3 produced the heaviest stalk weight of 1.30 kg followed by B2 with 1.14 kg, B4 with 0.92 kg and the lightest is produced by B1 with 0.91 kg. Result of the analysis of variance likewise revealed that the effect of furrow spacing is significantly different in terms of stalk weight with B3 and B2 significantly differing with B2 and B1.

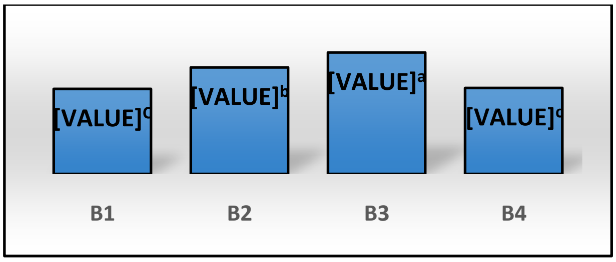

Figure 4. Effect of furrow spacing on stalk weight (kg)

As to the interaction effect of variety and furrow spacing, result of the analysis of variance bared that the effect is not significant on stalk weight.

Recovery Sugar

Figure 5 shows the recovery sugar (RS, %) as influenced by variety. As shown in the figure, V1 (Phil 99-1793) obtained the highest RS of 13.95% followed by V2 (VMC 84-524) with

12.48% and lowest was obtained by V3 (Phil 2000-2569) with 12.45%. Result of the analysis of variance, however, showed that there is no significant difference among varieties tested.

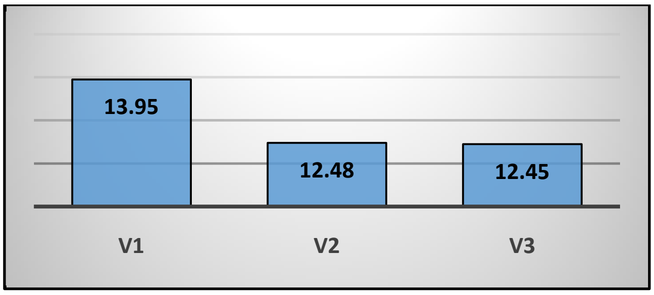

Figure 5. Varietal response to recovery sugar

Figure 6 on the other hand present the RS as influenced by the different furrow spacing tested. As gleaned from the figure, B2 produced the highest RS of 13.28% followed by B4 with 13.13%; B1 with 13.09% and the lowest is B3 with 12.32%. Analysis of variance further revealed that the effect of the furrow spacing tested on RS is insignificant.

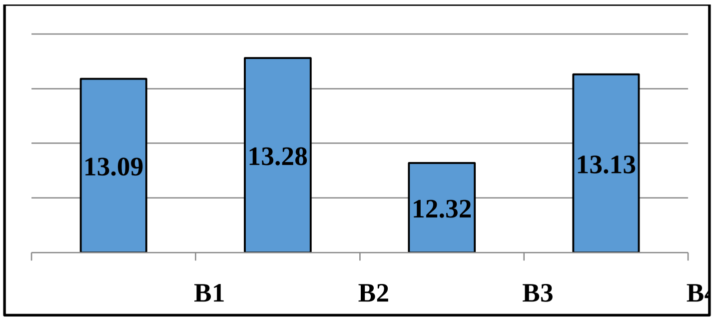

Figure 6.Effect of furrow spacing on the recovery sugar (%)

In terms of the interaction effect of variety and furrow spacing on the RS, there is no significant differences among the spacing tested as revealed by the result of the analysis of variance.

Computed Cane Yield

Figure 7 present the computed yield (tons/ha) as influenced by variety. As presented in the said figure, V3 produced the highest yield of 108.33 tons/ha followed by V2 with 101.95 tons/ha while V1 produced the lowest with 89.17 tons/ha. Result of the analysis of variance and DMRT further revealed that there is significant difference among the varieties tested in terms of cane yield with V3 and V2 significantly higher compared to V1.

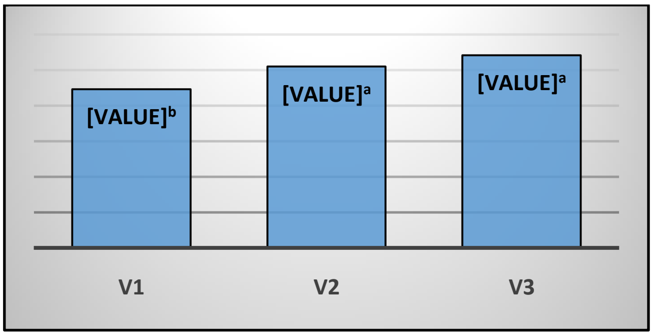

Figure 7. Varietal response on computed cane yield (tons/ha)

Figure 8 shows the computed cane yield as influenced by furrow spacing. As shown in the figure, B4 produced the highest computed cane yield of 112.66 tons/ha followed by B2 with 101.51 tons/ha; B3 with 99.80 tons/ha while B1 produced the lowest with 85.29 tons/ha. Result of analysis of variance further revealed that there is significant difference among furrow spacing tested. Moreover, DMRT analysis revealed that B2 and B4 are significantly higher compared to B1.

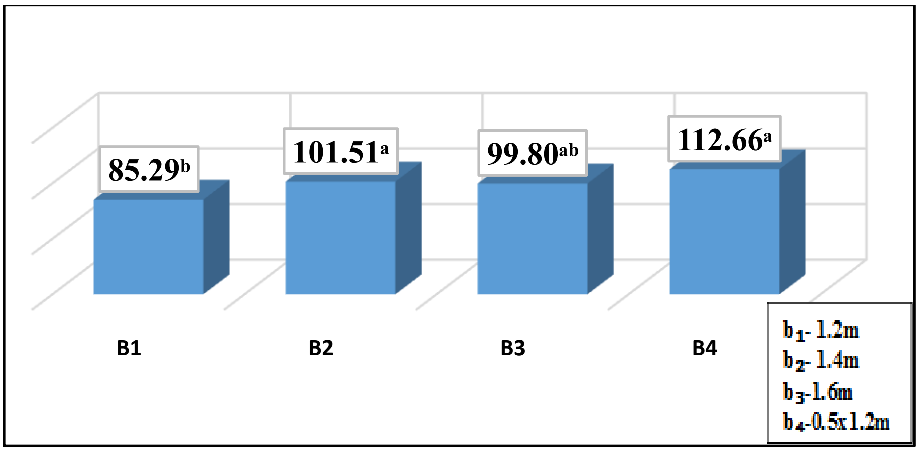

Figure 8.effect of furrow spacing on computed cane yield (ton/ha)

As to the interaction effect of variety and furrow spacing to computed cane yield (Figure 9), T12 ranked the highest cane yield of 130.79 tons/ha followed by T6 with0 120.73 tons/ha; T11 with 109.28 tons/ha; T8 with 103.75 tons/ha; T4 with 103.45 tons/ha; T10 with 100.42 tons/ha; T7 with 98.10 tons/ha; T9 with 92.82 tons/ha; T3 with 92.03 tons/ha; T5 with 85.20 tons/ha; T2 at 83.37 tons/ha; and T1 produced the lowest cane yield of 77.84 tons/ha. Result of the analysis of variance also revealed that there is significant difference among the treatments tested. DMRT analysis also showed that T12 is statistically comparable to T6 but significantly different to the rest of the treatments.

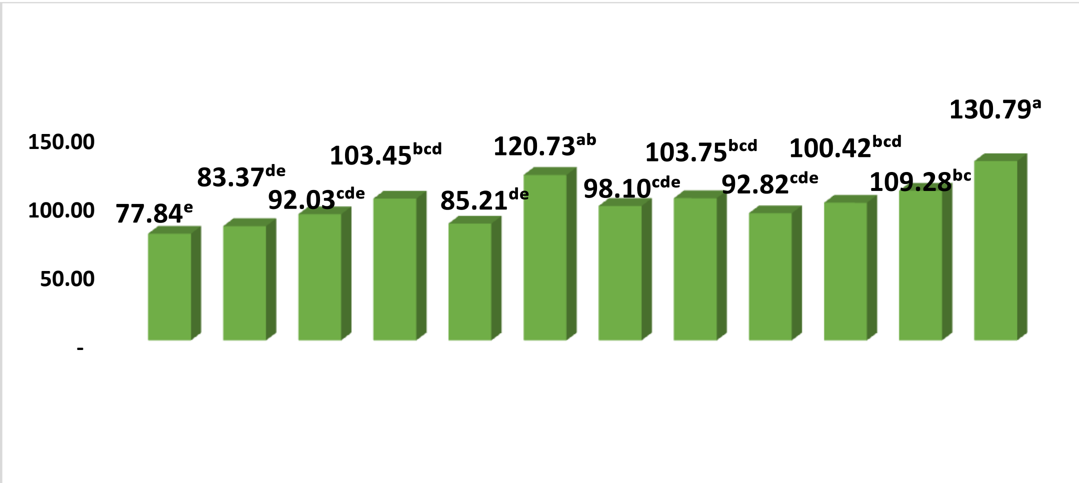

Figure 9. Interaction Effect by Variety and Furrow Spacing to Cane Yield (ton/ha)

Return on Investment

Based on the computed cane yield and sugar yield, the highest total net income per treatment was obtained by T6 with₱ 111,383.63 followed by T12 with ₱ 104,630.69; T8 with ₱ 97,065.13; T11 with ₱ 90,902.97; T4 with ₱ 85,198.80; T3 with ₱ 82,570.23; T10 with ₱ 81,077.83; T2 with₱ 78,766.71; T9 with₱ 67,353.54; T1 with ₱ 67,206.04; T7 with ₱ 50,991.44; and T5 obtained lowest net income at ₱ 47,961.89.

In terms of ROI (Figure 10), the treatment that gained the highest is still T6 with 50.49% followed by T11 with 46.71%; T8 with 46.32%; T12 with 46.12%; T3 with 45.85%; T2 with 45.12%; T10 with 44.30%; T4 with 43.12%; T1 with 41.31%; T9 with 40.04%; T7 with 33.84% while the lowest is T5 with 32.83%.

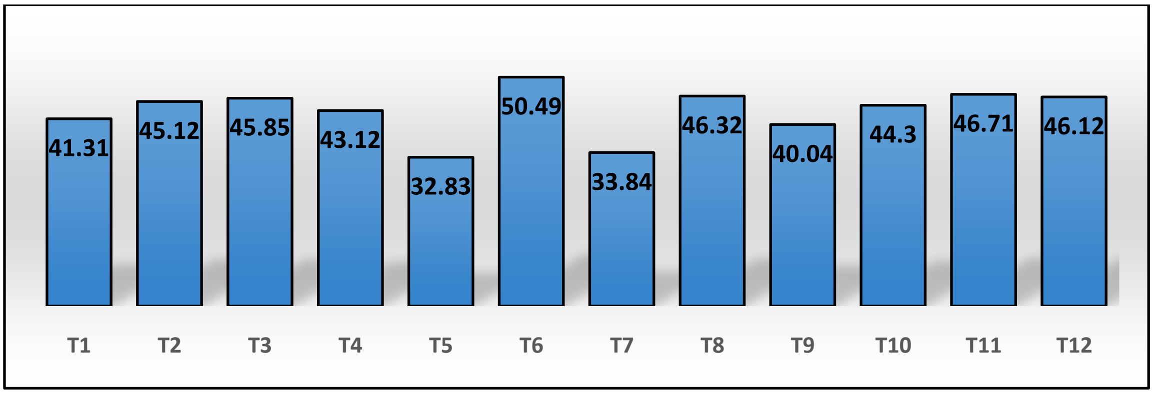

Figure 10. Return on investment

IV. CONCLUSION AND RECOMMENDATION

Conclusion

In the light of the findings of the study, the following are the conclusions:

- Plant height and recovery sugaris not significantly affected by variety and furrow spacing
- Phil 2000-2569 (V3) planted at 0.50 x 1.20 m (dual row) produced the highest number of millable stalks
- Phil 99-1793(V2) and Phil 2000-2569 (V3) planted at 1.60 m produced the heaviest stalk weight
- Phil 2000-2569(V3) planted at 0.50 x 1.20 m produced the highest cane yield
- VMC 84-524 (V1) and Phil 2000-2569(V3)gained highest income when planted at 1.60 m
- Phil 99-1793 (V2) produced the highest income and ROI when planted at 1.40 m

Recommendations

Based on the conclusions of the study, the following are recommended:

- The use of Phil 99-1793 variety planted at 1.40 m furrow spacing for higher net income
- Planting of Phil 2000-2569 at 0.50 x 1.20 m (dual row)
- Follow-up study should be conducted to further validate the findings of this study.

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