VSU TERMINAL REPORT FOR RESEARCH AND DEVELOPMENT

A. Bibliographic Data

1. Research Title: "PERFORMANCE OF THREE ONION VARIETIES UNDER THREE AGRO-ECOSYSTEM"

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9. Project Outputs

B. Technical Description

1. **Preliminaries**
   Title Page
   Bibliographic Data
   Table of Contents
   List of Tables, Figures, etc.
   Abstract

2. **Text**
   Introduction

Farming system in the Philippines is generally characterized by intensive farm production using synthetic fertilizers and pesticides. Onion (*Allium cepa* Linn.) is one among the different crops cultivated under conventional systems with too much application of inorganic fertilizer and use of pesticides to obtain desirable yield. Despite these, onion production in the country is far behind to meet the increasing demand. Thus, Jollibee Group Foundation (JGF) is aiming to expand the production of onion, particularly white onion, as an important ingredient to its food products using GAP (Good Agricultural Practices) that will increase the volume of production and augment the profit of the farmers without necessarily compromising the overall health of the soil as well as the human population.

Central Luzon is the biggest onion producer in the country, and undoubtedly, onion growing is one of the major factors attributing to increased income among farmers in the region, particularly, in Nueva Ecija (DA-PRDP Luzon A Cluster Report, 2014). Onion is grown as a secondary crop after rice and recognized to boost the income of many farmers, particularly in Nueva Ecija. However, most farmers growing onions in the region are dependent on chemical inputs to ensure high yield (Galindez, 2012) which entails high input cost. Especially for the past recent years, the cost for chemical fertilizers has skyrocketed and this is expected to continue to increase as reported in public news worldwide. Besides, excessive application of chemical inputs such as inorganic fertilizers and pesticides impose health hazard and environmental problem such as soil fertility decline, heavy metal accumulation, water eutrophication and accumulation of nitrate that resulted to air pollution and emission of other greenhouses gasses that could aggravate the effect of climate change (Savci, 2012).

The Central Luzon State University-Ramon Magsaysay Center for Agricultural Resources and Environment Studies (CLSU RM-CARES) initially thought of promoting a pure organic production system, particularly in onion farms. But since it takes time (about three years) to convert inorganic production system into pure organic system, the practical approach is to first introduce an organic-based farming system that uses a balanced fertilization scheme highlighting good agricultural practices employing both organic and inorganic fertilizers, biopesticides and the CLSU RM-CARES *Tricho* Plus developed by the Center as a biofertilizer and bio-control agent. This, however, would necessarily require the development, field testing and verification of the best combination of organic and chemical inputs for dissemination and use by onion farmers, hence the project.

Conventional onion production in Nueva Ecija requires excessive application of inorganic fertilizer and pesticides for maximum yield and protection from pests. The project showcased S and T interventions as an alternative to reduce use of inorganic inputs and promote environmental stability. Organic and organic- based production technologies were generated. In the pure organic system, results indicate that red creole and yellow granex varieties yielded highest, using organic fertilizer + Trichoderma Plus. Similarly, the two varieties yielded the same results in an organic-based system, in terms of using 50% inorganic fertilizer at recommended rate + 50% organic fertilizer + Trichoderma Plus.

Meanwhile, VSU Conducted a varietal trial on onions under rain-shelter structures. The four onion varieties were Red Colorado (Condor Seeds Co.), Red horse (Kaneko Seeds Co.), Red Winner (Kaneko Seeds Co.), and Yellow Granex (Ramgo Seeds Co.). Three of the varieties were red and one was Yellow onion the Yellow Granex. Results showed that the four varieties had no significant differences in terms of plant height, number of leaves, percent survival, cigar and plant biomass. Yellow Granex was early

maturing that exhibited 80% top-down after 66 days from transplanting while red varieties were late maturing having 74- 88 days. Yellow Granex had the least number of cigars and multiple bulbs, widest neck, equatorial and polar bulb diameter, highest percent moisture content and shoot dry matter but low in bulb dry matter than red varieties. On the other hand, red varieties had more undersized and small bulbs while the Yellow Granex had the greatest number of medium, large and oversized bulbs. The four varieties are suitable for planting in Leyte condition under a protective structure with Yellow Granex as the highest yielder (41-47% higher) and net returns were increased by 50-57% than red varieties.

Another experiment was also conducted using red variety of bulb onions applied with different organic fertilizers; T0 – 10g inorganic fertilizer alone, T1 – carabao manure + 10g inorganic fertilizer, T2 – chicken dung + 10g inorganic fertilizer, T3 – swine manure + 10g inorganic fertilizer and T5 – vermicompost + 10g inorganic fertilizer. Horticultural characteristics which include the weekly plant height, days to pseudostem collapse, number of leaves per plant, and neck diameter of bulb onion were significantly affected by the application of different organic fertilizers. Plants applied with chicken dung plus inorganic fertilizer were the tallest, had more and bigger leaves but delayed collapse of pseudostem, but statistically not different from carabao manure and vermicompost. Yield and yield components such as bulb size, weight per bulb, and yield were significantly increased with application of animal manures with chicken dung having the highest yield. Swine manure showed poorer results and was comparable with the control. The use of either chicken dung or vermicast as addition to the inorganic fertilizer had the best performance with respect to horticultural parameters and to yield and yield parameters.

At Bureau of Plant Industry-Baguio National Crop Research, Development and Production Support Center (BPI-BNCRDPSC) varietal trial in 2018 using Rio Bravo and Improved Red Express varieties in direct seeding with narrower planting distance matured at 110 and 120 days after sowing, and yielded 12 and 9 tons/ha, respectively(Jose,2018).
Theonionplantswerefertilizedbasallywithfourtons/ha organic fertilizer, and inorganic fertilizer at the rate of 130-130-130 N-P2O5-K2O in split application at planting and side dressing 45 days after sowing. Further, side dressing was followed immediately by hilling-up with a thin soil, while watering was done twice a week, and weeding twice during the cropping season. Further, thrips were present but insignificantly affected the crop since spraying of insecticide-fungicide solution was done regularly at 14-day interval.

These three institutions have different agro-climatic conditions which also means different cultural and nutrient management practices being employed to produce onion. This project will test the adaptability of the three onion varieties to be planted under different agro-ecosystem employing the farming practices applicable in each location.

The project team will be composed of representatives from the three institutions and shall be coordinated through the JGF. This will also entail site/ocular inspection, crop suitability evaluation of the land and several planning and monitoring meetings.

Review of Literature

Onion (*Allium cepa L.*) of the family Alliaceae, is one of the most important commercial vegetable crops cultivated extensively in the Philippines. Onion bulb is a rich source of minerals like phosphorus, calcium and carbohydrates. It also contains protein and vitamin C and is being used in

several ways as fresh, frozen and dehydrated bulbs. Onion has medicinal value containing anticancer agent which was shown to prevent cancer in animals (Bagali et al., 2012).

Conventional onion production requires too much application of inorganic fertilizer and pesticides to obtain maximum yield and to protect the crops from insect pest infestations. Due to increasing price of agricultural inputs, particularly fertilizer and pesticides, small farmers cannot cope with the situation. On the other hand, it has recently been found out that these harmful chemicals cause damage to the human immune system, thereby reducing the overall resistance of the body. Some farmers have already switched to organic onion cultivation. The reduced amount of toxins that are taken in by the consumer leads to increased and higher degree immunity and stamina for the consumer as compared to normally grown onions.

Farmers spend a greater portion of their capital for purchasing fertilizers. Generally excessive amounts of inorganic fertilizers are applied to vegetables in order to achieve a higher yield (Stewart *et al*., 2005). However, chemical fertilizers alone generate several deleterious effects to the environment and human health and they should be replenished in every cultivation season because, the synthetic N, P and K fertilizer is rapidly lost by either evaporation or by leaching in drainage water and it causes dangerous environmental pollution (Aisha *et al*., 2007).

Addition of organic fertilizer improves soil structure, which can encourage root development and leads to encouraging growth (Singer *et al.,* 1998). Yassen and Khalid (2009) showed that all organic fertilizer treatments; *i.e.* mixture of farmyard manure and chicken manure overcame the control treatment (recommended NPK) improved vegetative growth characters, essential oil, some of the main constituents of essential oil and NPK contents. Mineral fertilizers are one of the principle factors that materially set up onion growth and production. Since, onion plants take up large amounts of three primary nutrients, i.e. nitrogen, phosphorus and potassium since they are essential nutrients for plant growth and yield. Moursy et al. (2007) found that application of 190.4 kg N/ha gave significantly increased onion yield, bulb diameter and TSS content as compared with using nitrogen at a rate of 95.2 kg N/ha. Yaso et al. (2007) revealed that increasing mineral nitrogen levels led to significant increases on plant height, number of leaves, average bulb weight, marketable and total bulbs yield, and total soluble solid (TSS) of onion.

Objectives:

Generally, the project aims to evaluate the performance of three onion varieties planted at three locations.

The project will be implemented with the following specific objectives:

1. To establish an onion varietal trial under different agro-ecosystems in VSU, BPI- Baguio and San Jose City, Nueva Ecija, and
2. To evaluate the effect of agro-ecosystem's gradient on the bulb formation and growth parameters of the three onion varieties.

Methodology

Establishment of a Research Core Team (RCT)

The RCT was composed of technical experts in onion production, nutrient management, and pest and disease management, who convened based on the necessity for the formulation of necessary research protocols. At least one (1) member each from BPI-Baguio, VSU, and CLSU, with a

representative of JGF as coordinator, is also a member of the RCT. CLSU was the overall project lead, and they consolidated reports from the three project sites for presentation to JGF.

The three project locations have different soil and climatic gradients. Thus, the experimental design for this trial shall be a split-plot design with three replications, with variety as the main plot and fertilizer and pesticide application as the subplot.

Main Plot: Varieties (V)

V1- Golden Pinoy F1 (Check) V2- Superex
V3- Pirate F1

Sub-Plot: Treatment (T)

T1- Negative control (no application)
T2- Conventional method (Farmer's Practice using only chemicals)
T3- Chemical fertilizers (based on STK) + biopesticides only
T4- 1⁄2 chemical fertilizers + 1⁄2 biofertilizers + biopesticides only

Results and Discussion

VSU output

General Observation

Despite being planted under plastic roofing, transplanted onion seedlings (June 20, 2023), were adversely affected by frequent rains and high relative humidity (Fig. 1) during the first 5 weeks. This resulted in a pale-green appearance (Fig. 2) and sluggish, uneven growth due to the limited exposure to sunlight. Newly transplanted seedlings were applied with treatments in accordance to its assigned rates of in combination of synthetic fertilizers, bio-organic fertilizers and biopesticides. Blanket application of starter solution (1tbsp urea/gallon of water) were supplemented through drenching onto the all-treatment plots. It was also observed that application of herbicide 7th and 10th days after transplanting at 4 tbsp per 16 liters resulted to partial stunting of growth of bulb onions. Half strength of the indicated dosage is advisable.

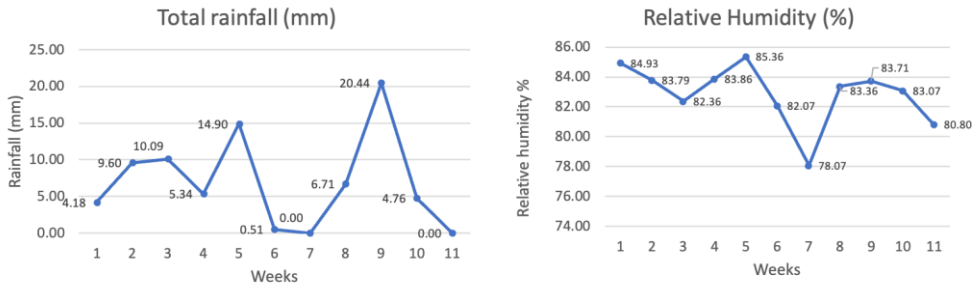

Fig 1. Total weekly rainfall (mm) and Relative humidity (%) from 1st to 11th week after transplanting

Figure 2. Two-week old onion var. Superex, Golden Pinoy, Pirate,

Plant Height

Table 1a shows the effect of different combinations of bio-organic fertilizers and biopesticides on the plant height of three onion varieties (Superex, Golden Pinoy, and Pirate) from 1st to 4th week after transplanting. It was observed that regardless of different fertilizer sources and biopesticides application, height of the three varieties were just statistically the same. However, onion plants regardless of varieties treated with T1 (control), T2 (inorganic fertilizer+ inorganic pesticides and T3 (inorganic fertilizer + biofertilizer + biopesticides) were comparably taller of 32.27 – 34.84 cm, than treated with T4 (half inorganic fertilizer + half biofertilizer + biopesticides) which is only 29.47 cm tall. The data suggests that the application of bio-organic fertilizers and biopesticides can enhance the growth of onion plants, but the effect may vary depending on the onion variety and the proportion of inorganic and organic inputs.

Variety x Treatments interaction

The data reveals distinct responses across treatments and varieties. In the control group (T1), Superex has the lowest height at 30.20 cm, while Golden Pinoy and Pirate exhibit intermediate heights of 38.62 cm and 35.72 cm, respectively, resulting in an overall treatment mean of 34.84 cm. Farmer's practice (T2) results in reduced heights for both Superex and Golden Pinoy, with an overall treatment mean of 32.27 cm. Notably, T3, involving inorganic fertilizer, biofertilizer, and biopesticides, leads to a significant increase in the height of Superex to 40.43 cm, while Golden Pinoy and Pirate show moderate heights, contributing to a treatment mean of 34.80 cm. T4, with a combination of half inorganic fertilizer and half biofertilizer with biopesticides, results in the shortest heights for all varieties, with an overall treatment mean of 29.47 cm. The variety mean indicates a subtle difference in height among Superex, Golden Pinoy, and Pirate. Overall, the data suggests that the interaction between onion varieties and the application of bio-organic fertilizers and biopesticides plays a crucial role in influencing the height of bulb onions, providing valuable insights for optimizing growth conditions in onion cultivation.

Table 1a. Plant height (cm) of different onion varieties at 1st to 4th weeks from transplanting as affected by different combinations of bio-organic fertilizers and biopesticide

Treatments	Plant Height (cm) weeks after transplanting (WAT)			
	1WAT	2WAT	3WAT	4WAT
Main plot- Onion Varieties				
Superex	17.11	24.03	27.69	32.622
Golden Pinoy	16.53	26.28	31.04	33.576
Pirate	17.11	27.12	29.60	32.342
Subplot- Biofertilizer and biopesticides treatments				
T1	16.41	24.83	28.64	34.84[a]
T2	15.92	26.20	29.18	32.27[ab]
T3	15.92	26.27	29.39	34.80[a]
T4	14.91	25.93	30.55	29.47[b]
CV- variety	21.62	12.17	13.29	5.15
CV- treatments	6.02	5.38	4.19	8.85

Means within a column in a block followed by a common letter and/ or no letter designation are not significantly different from each other at 5% level of significance using Least Significant Different (LSD)

T1- Control (no application)
T2- inorganic fertilizer+ inorganic pesticides (farmer's practice)
T3- inorganic fertilizer +biofertilizer+biopesticides
T4-1/2 inorganic fertilizer+1/2 biofertilizer+biopesticides

Tale 1b. Interaction effects of varieties and different combinations of bio-organic fertilizers and biopesticides on the height of Bulb onions at 4th week from transplanting

Treatments	Superex	Golden Pinoy	Pirate	Treatment Mean
T1	30.20[d]	38.62[ab]	35.72[bc]	34.84
T2	31.33c[d]	28.77[d]	36.70[ab]	32.27
T3	40.43[a]	37.05[ab]	26.92[d]	34.80
T4	28.5[d]	29.87[d]	30.03[d]	29.47
Variety Mean	32.62	33.58	32.34	

Means within a column in a block followed by a common letter and/ or no letter designation are not significantly different from each other at 5% level of significance using Least Significant Different (LSD)
T1- Control (no application)
T2- inorganic fertilizer+ inorganic pesticides (farmer's practice)
T3- inorganic fertilizer +biofertilizer+biopesticides
T4-1/2 inorganic fertilizer+1/2 biofertilizer+biopesticides

Yield and Yield Components

The data presented in Table 2a explores the impact of different combinations of bio-organic fertilizers and biopesticides on the yield and yield components of various onion varieties. In the main plot focusing on onion varieties, Superex exhibited a bulb size (Fig. 3) of 38.83 mm (Polar) and 32.84 mm (Equatorial), with a weight per bulb of 23.35 g and a yield of 5.84 t/ha. Golden Pinoy, on the other hand, displayed a larger bulb size (42.07 mm Polar, 34.48 mm Equatorial), a weight per bulb of 27.33 g, and the highest yield of 6.83 t/ha. Pirate, with a smaller bulb size, yielded 5.26 t/ha. In the subplot analyzing biofertilizer and biopesticide treatments, T3 stood out with the highest yield of 6.57 t/ha, associated with a bulb size of 39.56 mm (Polar) and 34.49 mm (Equatorial). The control (T1) and the farmer's practice (T2) showed lower yields, indicating the positive impact of incorporating biofertilizer and biopesticides.

Variety x Treatments interaction

Table 2b examines the interaction effects of different onion varieties and combinations of bio-organic fertilizers and biopesticides on the weight of onion bulbs. In this analysis, three onion varieties-Superex, Golden Pinoy, and Pirate-are subjected to four distinct treatments. The control group (T1) shows that Superex, Golden Pinoy, and Pirate have weights of 39.13 g, 41.47 g, and 33.00 g, respectively, contributing to an overall treatment mean of 37.87 g. The farmer's practice (T2) exhibits slightly lower weights for all varieties, with a treatment mean of 35.93 g. Notably, T3, involving inorganic fertilizer, biofertilizer, and biopesticides, enhances the weights of Superex and Golden Pinoy to 41.27 g and 40.83 g, respectively, resulting in a higher treatment mean of 39.56 g. T4, with a combination of half inorganic fertilizer and half biofertilizer with biopesticides, yields the highest weights for all varieties, with a treatment mean of 40.62 g. The variety mean provides an overview of the overall performance, showing that Golden Pinoy tends to have the highest weight among the three varieties. Overall, the results suggest that the combined application of bio-organic fertilizers and biopesticides, especially in T4, has a positive impact on enhancing the weight of onion bulbs, with variations observed across different onion varieties.

Table 2a. Yield and yield components of onion varieties as affected by different combinations of bio-organic fertilizers and biopesticide

Treatments	Bulb size (mm)		Yield		
	Polar	Equatorial	Weight per blub (g)	Yield per plot (g/2m^2)	Yield (t/ha)
Main plot- Onion Varieties					
Superex	38.83a	32.84	23.35ab	1167.40ab	5.84ab
Golden Pinoy	42.07a	34.48	27.33a	1366.70a	6.83a
Pirate	34.58b	31.85	21.05b	1052.50b	5.26b
Subplot- Biofertilizer and biopesticides treatments					
T1	37.87ab	32.93ab	24.09ab	1204.80ab	6.02ab
T2	35.93b	30.26b	19.17b	958.30b	4.79b
T3	39.56a	34.49a	26.29a	1314.40a	6.57a
T4	40.62a	34.56a	26.09a	1304.40a	6.52a
CV- variety	7.32	10.88	20.16	20.16	20.16
CV- treatments	5.00	10.63	10.63	24.64	24.64

Means within a column in a block followed by a common letter and/ or no letter designation are not significantly different from each other at 5% level of significance using Least Significant Different (LSD)

T1- Control (no application)
T2- inorganic fertilizer+ inorganic pesticides (farmer's practice)
T3- inorganic fertilizer +biofertilizer+biopesticides
T4-1/2 inorganic fertilizer+1/2 biofertilizer+biopesticides

Tale 2b. Interaction effects of onion varieties and different combinations of bio-organic fertilizers and biopesticides on its weight per bulb (g).

Treatments	Superex	Golden Pinoy	Pirate	Treatment Mean
T1	39.133abc	41.47ab	33.00c	37.87
T2	33.80c	40.27ab	33.73c	35.93
T3	41.27ab	40.83b	36.6bc	39.56
T4	41.13ab	45.73a	35.00bc	40.62
Variety Mean	38.83	42.07	34.58	

Means within a column in a block followed by a common letter and/ or no letter designation are not significantly different from each other at 5% level of significance using Least Significant Different (LSD)

T1- Control (no application)
T2- inorganic fertilizer+ inorganic pesticides (farmer's practice)
T3- inorganic fertilizer +biofertilizer+biopesticides
T4-1/2 inorganic fertilizer+1/2 biofertilizer+biopesticides

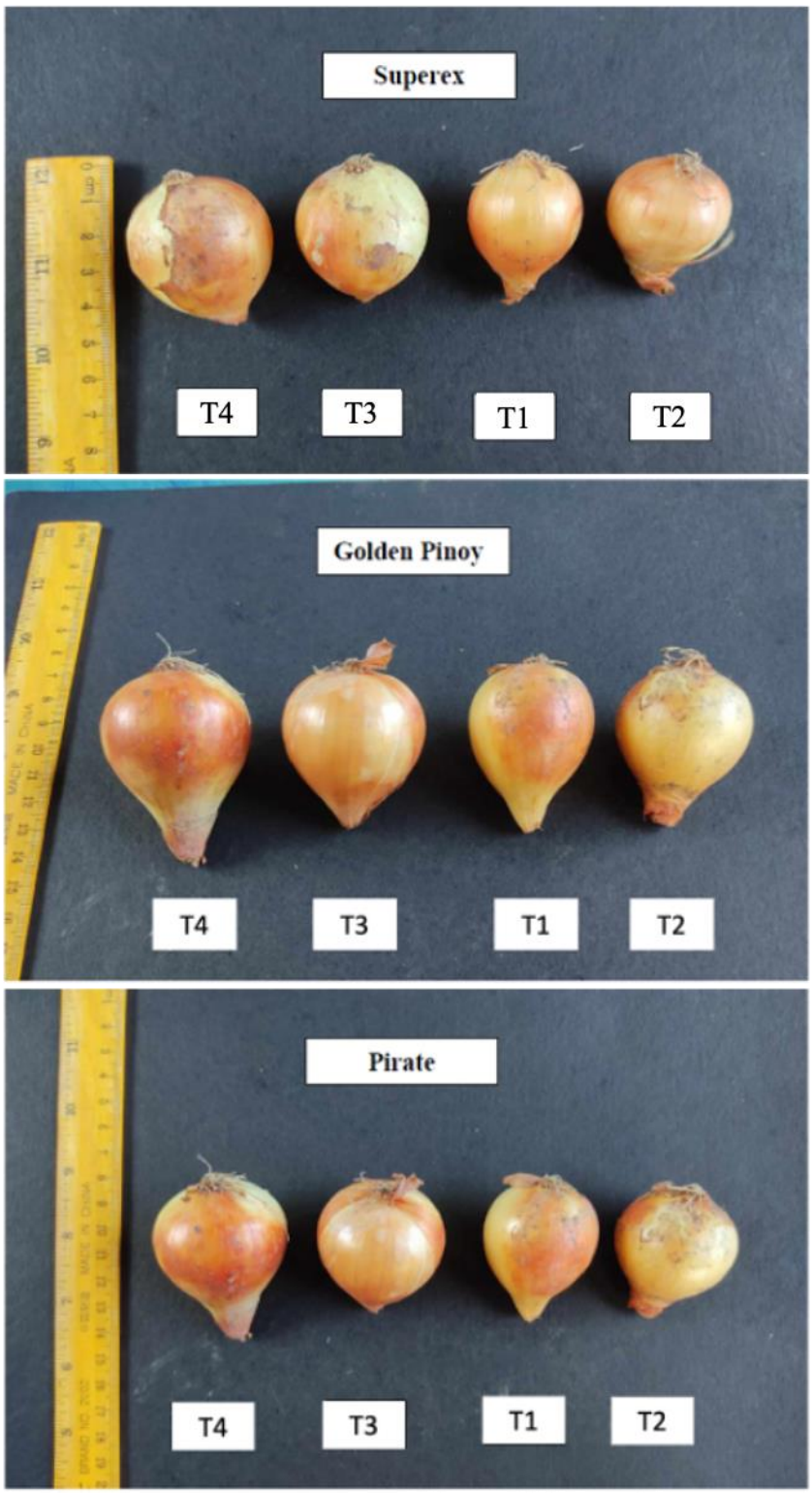

Fig 3. Bulb onion varieties Superex, Golden pinoy and Pirate showing bulb sizes from Largest to smallest (left to right)

SUMMARY AND CONCLUSIONS

In summary, the comprehensive analyses of the provided data shed light on the influence of different combinations of bio-organic fertilizers and biopesticides on plant height, yield, and bulb weight in three onion varieties (Superex, Golden Pinoy, and Pirate). In terms of plant height (Table 1a), the data suggests that, despite variations in fertilizer sources and biopesticide applications, the plant heights of the three varieties were statistically similar. However, treatments incorporating bio-organic fertilizers and biopesticides (T1, T2, and T3) resulted in taller onion plants compared to the treatment with a combination of half inorganic fertilizer and half biofertilizer with biopesticides (T4).

Golden Pinoy, with the largest bulb size, exhibited the highest yield, indicating the importance of variety-specific considerations in onion cultivation. The subplot analyzing biofertilizer and biopesticide treatments further underscores the positive impact of incorporating biofertilizer and biopesticides on yield. The combined application of bio-organic fertilizers and biopesticides, particularly in T4, led to the highest weights for onion bulbs. The variety mean suggests subtle differences in weight among Superex, Golden Pinoy, and Pirate, emphasizing the need for tailored agricultural practices considering both the specific onion variety and the composition of bio-organic inputs.

Overall, these findings provide valuable insights for optimizing growth conditions and enhancing yield in onion cultivation. The data highlights the complexity of the interactions between onion varieties and the application of bio-organic inputs, emphasizing the need for a customized approach to achieve optimal results in onion farming.

RECOMMENDATIONS

1. The same experiment should be conducted during dry season (February to May) to determine the yield at full maturity of bulb onions.

2. The application of inorganic fertilizers + biofertilizers + biopesticides is recommended for its positive growth and yield performance on onion plants

Literature Cited

Appendices