Effect of plant growth substances and bio-enhancer on the enhancement of bulblet growth under the in-vivo condition of *Lilium spp.*

Abstract

Lilies are one of the most extensively sold cut flowersdue to their quantity and variety of colours (Bala*et al.*, 2019)[1].The genus *Lilium*is among the top-cut flowers in the world.Lilies typically reproduce sexually through seeds or asexually through the growth of daughter bulbs, axillary bulblets that form in the axils of leaves, stem bulblets that form underground or above ground, and scales (Hartmann *et al.*, 1997)[6].According to the findings of an experiment done by Islam and Shimasaki (2019)[8], the conventional pathway required 3–4 growing seasons for the course of bulblet growth to bulb and ontogenic development to reach the adult flowering phase.So this study aims the development of bulbs from microbulblets by the use of different bio-enhancers and growth substances to decrease the time for bulblet growth to bulb and ontogenic developmentThe experiment was carried out in the Department of Horticulture, Sikkim University in the year 2016-2017 to find out the effect of growth substances and bio enhancers on the enhancement of microbulblets*in vivo* condition of *Lilium*spp.A completely randomized block design was used to conduct the experiment (CRD) which was replicated thrice and the details of the treatments were: T_1-Paclobutrazol-10ppm, T_2-Paclobutrazol-20ppm, T_3-Paclobutrazol- 30ppm, T_4-Thiourea - 10ppm, T_5-Thiourea - 20ppm, T_6-Thiourea - 30ppm, T_7-Cow urine - 10%, T_8- Vermiwash-100%, T_9- Vermiwash - 50% and T_{10}- Control. The treatments were sprayed at 15, 30 and 45 days intervals. Among all treatmentsused for the development of bulbs from microbulblets, the performance of the growth substance was found more effective. Parameters like bulb weight, bulb length and bulb breadth were recorded maximum under treatment paclobutrazol 10ppm (T_1) and paclobutrazol 20ppm (T_2). However, organic bio enhancers like vermiwash 100% (T_7) and vermiwash 50% (T_8) were found at par with the above treatments. The maximum amount of carbohydrate accumulated was observed in thiourea 10ppm (T_{14}), which was at par with vermiwash 100% (T_7) and vermiwash 50% (T_8).Keeping in view the results obtained in the study for the regeneration of microbulblets from scale and development of bulbs from microbulblets, bio enhancers like vermiwash and cow urine can be used as substitutes for the chemical growth substances in organic farming and can be recommended to the farmers.

Keywords:-*Lilium* spp., Microbulblet, growth substances, bio-enhancers

Comment [A1]: This article needs serious major revision
Every section should be rewritten taken into consideration that the short and descriptive sentences are the best in interpreting the obtained data
Recent and more related references are urgently needed

Comment [A2]: This part is not suitable here, it should be transferred to the introduction section

Comment [A3]: Mention the treatments in concise sentence

Comment [A4]: It is too long
You have to concentrate on the regulators and organic additives for example, ... application of paclobutrazol at 10 ppm resulted in the highest values of ..... and so on

Introduction

Lilies are one of the most extensively sold cut flowersdue to their quantity and variety of colours (Bala*et al.*, 2019)[(1)].The genus *Liliumis* among the top-cut flowers in the world.Lilies typically reproduce sexually through seeds and asexually through the growth of daughter bulbs, axillary bulbletswhich form in the axils of leaves, stem bulbletswhich form underground or above ground, and scales (Hartmann *et al.*, 1997) ([6)].Lily bulb production is a highly complex process, which cannot be fully understood by analysis at any one specific method (i.e., conventional, *in vitro*). In general,'scaling' is used in conventional bulb production. However, the scaling process is extremely slow and takes a lot longer to complete than the bulblet expansion (size) and ontogenic development. According to the findings of an experiment done by Islam and Shimasaki (2019)[(8)], the conventional pathway required 3–4 growing seasons for the course of bulblet growth to bulb and ontogenic development to reach the adult flowering phase.During the growth of a lily bulb, three ontogenic phases, namely the juvenile, vegetative adult, and flowering phases, occur (Rees, 2012[(14)];Langens-Gerrits*et al.*, 2003)[(10)].Park (1996)[(13)]also stated that commercial-size bulbs are obtained only after 3-4 years.The demand for high-quality planting materials is one of the major obstacles to the expansion of horticulture crops, especially in the floriculture sector.Additionally, most of the bulbs used in Lilium's commercial manufacturing are expensive, imported bulbs.Currently, India imports Lilium bulbs from other countries to utilise in the production of flowers. According to Bale *et al.*[(1)],the Netherlands is the top exporter and supplier (2019). As stated by Panda &Mohanty, (2016)[(12)], there has been a lot of interest in Lilium bulb production in vivo for commercial production. However, adequate information about growth substances, bio-enhancers, and in vivo conditions is still being determined.So differentgrowth substances and bio-enhancersin vivo conditions can be utilised for the development of bulbs from bulblets and thereby decreasing the period for bulb production. Therefore, to reduce the bulb cost and to meet the increasing demand for flowers throughout the year by providing sufficient planting material, there is an urgent need to develop cheaper multiplication techniques indigenously to increase bulblet production.So this study aims the development of bulbs from microbulblets by the use of different bio-enhancers and growth substances

Comment [A5]: Very poor language and unclear objective

Materials and Methods

For the development of microbulblets into the bulb, a study was conducted under the medium cost poly house of the Department of Horticulture, Sikkim University. The microbulblets were of local varietyand were collected from farmer's fields. They were adequately cleaned, treated with fungicide, dried, and then planted in disposable plastic cups filled with coco peat, perlite, and compost (1:1:1 ratio) as growing media. A completely randomized design(CRD) was used to conduct the experiment which was replicated thrice and the details of the treatments were as follows: T_1- Paclobutrazol@10ppm,T_2-Paclobutrazol@20ppm,T_3-Paclobutrazol@30ppm, T_4-Thiourea@10ppm, T_5-Thiourea@20ppm T_6- Thiourea@30ppm,T_7-Cow urine@10%, T_8- Vermiwash@100%, T_9-Vermiwash@50% and T_{10}- Control. The treatments were sprayed at 15, 30 and 45 daysintervals. Development of bulbs from microbulblets, fresh weight of the bulb, size of bulb, root, and shoot development of bulb was recorded. Also, chlorophyll content from leaves and moisture and carbohydrate content from bulbs was calculated after 30, 60, and 90 days of the spray of treatments

Irrigation was done in both experiments periodically, and *Artemisia* sp. spray was used as per requirement for protection from fungal infection (Hrytsyk*et al*., 2021)[7]. The data were analyzed statistically using a completely randomized design. The critical difference at 5 per cent of significance level for each character was worked out to compare the significance among the treatment mean.

Comment [A6]: It is vague section
More details about the experimental conditions are needed
Are the bulbs only supplied with organic?
What about other macro and micronutrients needed for health growth?
What is the chemical composition of growth media, coco peat, perlite and compost?

Result and Discussion

Effect of different treatments on the average value of carbohydrate content of the bulb after 30, 60 and 90 days after spraying of treatments.

It was evident from Table 1. that the maximum carbohydrate content after 30 days was recorded in treatment T_6 (62.57) under thiourea@30ppm and the minimum carbohydrate content was recorded in T_9 (16.94) under vermiwash@50%which had no significant difference.

According to the data in table 2.the average amount of carbohydrate content after 60 days was significant among various treatments. The maximum average amount of carbohydrate content was recorded in treatment T_4 (thiourea@10ppm) i.e., 76.31, which was found statistically at par with T_5 (thiourea@20ppm), i.e., 72.77, T_8 (vermiwash@100%) i.e., 71.44, T_7 (cow urine @10%), i.e., 65.23 and T_6 (thiourea@30ppm) i.e., 56.81, and the

minimum average amount of carbohydrate content was recorded in treatment T_{10} (22.69) under control.

A study of the data presented in table 3 revealed that the maximum average carbohydrate content was found in treatment T_7 (cow urine @10%) i.e., 78.97 after 90 days of the spray of treatments which did not differ significantly from other treatments. Treatment T_{10} (47.95) under control showed the minimum average carbohydrate concentration.

Thiourea was the most effective in the enhancement of bulblets. Nitrogenous compounds increase the protein level in the explants during differentiation resulting in a higher number of bulblets (Kumar *et al.*, 2007)[9].Therefore the presence of nitrogenous compounds in cow urine and vermiwash could have aided in increasing the size of the microbulblet and also the carbohydrate accumulation in the bulb.In their experiment, Zheng *et al*. (2007)[16] confirmed that plant growth retardants CCC and PBZ could stimulate the formation of new scales of lily bulbs and promote starch and sucrose contents in an in vitro environment in bulbs during and after the blossoming period.

Effect of different treatments on the average value of chlorophyll content (ug/ml) in the leaves after 30, 60 and 90 days after spraying of treatments.

The results revealed from Table 1 that the chlorophyll content highly varied significantly among different treatments after 30 days of spraying treatments. Maximum average chlorophyll content was observed in treatment T_9 (9.34 ug/ml) i.e., vermiwash@50%, which was at par with T_6 (8.44 ug/ml) i.e.,thiourea @30ppm and T_5 (7.03 ug/ml) i.e.,thiourea@20ppm. While the minimum average chlorophyll content was observed in T_3 (4.58 ug/ml) i.e., paclobutrazol@30ppm, which was at par with T_{10} (6.00 ug/ml) i.e., control and T_8 (5.48 ug/ml))i.e., vermiwash@100%.

Different treatments significantly influenced chlorophyll content after 60 days of the spray of treatments (Table 2). Here too, treatment T_9 (10.12ug/ml) i.e.,vermiwash@50%, showed the maximum average value of chlorophyll content, which was at par with treatment T_4 (8.96 ug/ml) i.e., thiourea@10ppm. And treatment T_2 (3.82ug/ml) i.e.,paclobutrazol @20ppmshowed the minimum average value of chlorophyll content, which was at par with T_7 (4.66 ug/ml) i.e., cow urine @10%, T_8 (4.57 ug/ml) i.e., vermiwash@100%, T_3 (4.18 ug/ml) i.e., paclobutrazol@30ppm and T1 (4.14 ug/ml) i.e., paclobutrazol@10ppm

A non-significant difference was observed concerning average chlorophyll content after 90 days of the spray of treatments as per the data presented in Table 3. The maximum and minimum average chlorophyll content was recorded in control (T_{10})i.e.,4.00 ug/ml and thiourea@30ppm (T_6)i.e.,3.01 ug/ml respectively.

Comment [A7]: Similar way of data interpretation is repeated in every subsection of results and discussion
Very poor language
Mostly, the authors dependent on one reference for discussing their results Zheng *et al.* (2012)

Comment [A8]: 2007 or 2012 !!!!!!!!!!!!!!!!!!

According to the data, vermiwash@50% gave maximum chlorophyll content in the leaves, which was at par with the use of thiourea. However, using vermiwash 100% reduced the average chlorophyll content. Nitrogenous compounds in vermiwash and thiourea could have increased the chlorophyll content. As Bojovic and Markoviv (2009) [(2)] discussed, nitrogen in cow urine is a growth booster as there was a close link between chlorophyll and nitrogen in the leaf. Similar findings have been found by Tucker (2004)[(15)] and Daughtry*etal.* (2000)[(4)], as nitrogen is the structural element of chlorophyll and protein molecules and thereby affects the formation of chloroplast and the accumulation of chlorophyll in them.

Using paclobutrazol and cow urine reduced the average chlorophyll content in the leaves. This may have occurred due to the reduced size of leaves because of the use of growth retardant. However, this result contradicted the findings of Zheng *et al.* (2012)[(16)]. According to Zheng *et al.* (2012)[(16)], CCC and PBZ treatments enhanced chlorophyll a and b contents and inhibited the reduction that usually occurred during vegetative growth. Furthermore, the findings of Bojovic and Markoviv (2009) [(2)] have been mentioned above.

Effect of different treatments on an average value of moisture content (%) in the bulb after 30, 60 and 90 days after spraying of treatments.

After 30 days of the spray of treatments, the result in table 1 revealed a non-significant difference among different treatments. The value ranged from 88.50% to 76.33% in paclobutrazol@20ppm(T2) andCow urine @10%(T_7) respectively.

Data presented in Table 2 for the average moisture content of bulbs under different treatments was recorded as significantly variant after 60 days of the spray of treatments. The maximum moisture content (75.74%), was observed when treated with paclobutrazol@20ppm(T_2) which was found statisticallyat par with treatments T_5 (72.95%) i.e.,thiourea@20ppm, T_4 (71.69%) i.e.,thiourea@10ppm, T_{10} (71.21%) i.e., control, T_1 (71.8%) i.e.,paclobutrazol @ 10ppm, T_6 (70.45%) i.e.,thiourea@30ppm, T_7 (66.79%) i.e.,cow urine @10%, and T_3 (65.49%) i.e.,paclobutrazol @30ppm. The minimum moisture content was observed in treatment T_8 (51.78%) i.e.,vermiwash@100%.

Different treatments showed a significant influence on average moisture content after 90 days of the spray of treatments (Table 3). Among the treatments, treatment T_4 (65.76%) i.e.,thiourea@10ppm showed maximum average moisture content, which was at par with T_5(64.09%) i.e.,thiourea @20ppm, T_9(63.91%) i.e.,vermiwash@50% and T_2(60.28%) i.e.,paclobutrazol @20ppm and the minimum average moisture content was in T_{10} (43.20%) i.e., control.

Moisture content is inversely related to carbohydrate content. If there is an increase in carbohydrate content, there will be a decrease in the moisture content of the bulb. Using different growth substances and bio enhancers like paclobutrazol, thiourea, vermiwash etc., increases carbohydrate content, decreasing moisture content. In their experiment, Zheng *et al*. (2012)[16] confirmed that plant growth retardants CCC and PBZ could stimulate the formation of new scales of lily bulbs and promote starch and sucrose contents in an in vitro environment but also bulbs during and after the blossoming period.

Effect of different treatments on an average value of bulb weight (g) after 30, 60 and 90 days after spraying of treatments.

The observation made in table 3, the effect of different treatments on the average weight of the bulb, was found to be significant after 30 days of the spray of treatments. The minimum average weight of the bulb was recorded in treatment T_{10} (0.16g) i.e., control which was at par with T_4 (0.40g) i.e.,thiourea @10ppm, T_7 (0.36g) i.e., cow urine @10%, T_8 (0.29g) i.e.,vermiwash@100%, T_5 (0.28g) i.e.,thiourea@20ppm and T_6 (0.25g) i.e.,thiourea@30ppm. The maximum average weight was recorded in T_1 (0.67g) i.e.,paclobutrazol @10ppm, which was at par with T_2 (0.47g) i.e.,paclobutrazol @20ppm and T_9 (0.46g) i.e.,vermiwash@50%.

A glance at the data presented in table 2analyzed that the effect of different treatments on average bulb weight after 60 days of the spray of treatments was found highly significant. Paclobutrazol @10ppm (T_1) recorded the maximum average weight of the bulb (0.88gm) which was statistically at par with treatment T_3(0.67g) i.e.,paclobutrazol@30ppm. Control (T_{10}) recorded minimum weight of the bulb (0.23g), which was at par with treatments T_7(0.41g) i.e., cow urine @10%, T_8(0.40g), i.e.,vermiwash@100%, T_9(0.36g) i.e.,vermiwash@100%, T_5(0.35g) i.e.,thiourea@20ppm and T_4(0.31g) i.e.,thiourea@10ppm.

Data in table 3 shows that different treatments significantly affected the average bulb weight recorded on the 90th day. The maximum bulb weight observed in treatment treated with thiourea@30ppm (1.38g), which was at par with treatments T_2(1.27g) i.e.,paclobutrazol@20ppm, T_4(0.97g) i.e.,thiourea@10ppm, T_8 (0.96g) i.e.,vermiwash@100% and T_7 (0.94g) i.e., cow urine @10%. In contrast, the minimum average bulb weight observed in control (T_{10}) (0.19g) was at par with treatment T_1(0.43g) i.e.,paclobutrazol@10ppm.

Using different growth retardants and growth substances may have aided in the increase of bulb weight. Plant growth retardants exerted a long-term influence on bulb scale formation and carbohydrate accumulation, probably due to their manipulation of exogenous

hormones. Using growth retardants like paclobutrazol decreases the GA content. The decrease in the GA content is necessary for bulb formation and leads to the accumulation of carbohydrates, thereby increasing bulb weight. Zheng *et al*., (2012)[16] noticed a similar result in the Lilium bulb in the Lilium Oriental hybrid 'Casa Blanca'. Urea and its derivatives also stimulate bulbs' weight, which Kumar *et al*., (2007) [9]found. In Gladiolus, the weight of cormels per plant was to be maximum with GA3 150 ppm, SA 150 ppm and thiourea 2%, as observed by Padmalatha e*t al.,* 2013[11]. The use of Thiourea also increased the bulb size in garlic, as found by Chattopadhyay *et al*., 2015 [3] .

Effect of different treatments on the average value of bulb length (mm) and bulb breadth (mm) after 30, 60 and 90 days after spraying of treatments.

Table 1 represents the observation recorded for the average bulb length and average bulb breadth and the data obtained was significant and highly significant, respectively. The maximum average length of the bulb was obtained at treatment T_1(16.19mm) i.e.,paclobutrazol@10ppm, which was found at par with T_3(14.04 mm) i.e.,paclobutrazol@30ppm and the minimum average length of bulb was obtained at treatment T_{10}(9.15mm) i.e., control which was found at par with T_4(12.04mm) i.e.,thiourea@10ppm, T_5(11.46mm) i.e.,thiourea@20ppm, T_8(11.27mm) i.e.,vermiwash@100%, T_7(11.18mm) i.e., cow urine @10%, T_9(11.05mm) i.e.,vermiwash@50% and T_6(9.95mm) i.e.,thiourea@30ppm. The maximum average breadth recorded in treatment T_1 (11.41mm) i.e.,paclobutrazol@10ppm, which was at par with T_3 (10.44mm) i.e.,paclobutrazol@30ppm and T_2 (9.78mm) i.e.,paclobutrazol@20ppm and the minimum average breadth recorded in treatment T_{10} (6.47mm) i.e., control which was to be at par with T_6 (7.49mm) i.e.,thiourea@30ppm.

The result in table 2 shows that the effect of different treatments on the average length and breadth of the bulb was highly significant after 60 days of spray. Treatment T1 i.e.,paclobutrazol@10ppm, showed the maximum average length of the bulb(18.13mm) and treatment T_{10}i.e., control, showed the minimum average length of the bulb(10.16mm). Statistically at par values with the maximum value was recordedwith treatments T_8 (12.16mm) i.e.,vermwash@100%, T_9 (12.08mm), i.e.,vermiwash@50%, T4 (11.72mm) i.e.,thiourea@10ppm and T_5 (11.19mm) i.e.,thiourea@20ppm. The maximum average bulb breadth was recorded in treatment T_1 (12.77mm) i.e.,paclobutrazol@10ppm, which was found at par with treatments T_3 (11.54mm) i.e.,paclobutrazol@30ppm and T_6 (11.3mm)

i.e.,thiourea@30ppm and the minimum bulb breadth was recorded in treatment T_{10} (7.34mm) i.e., control which was at par with treatment T_4 (8.65mm) i.e.,thiourea@10ppm.

Table 3 represents the observations for the average length and breadth of the bulb on the 90th day, and the observations were highly significant. Treatment T_2(20.01mm) i.e.,paclobutrazol@20ppm, recorded the maximum average length of the bulb, which was at par with treatments T_6 (17.45mm) i.e.,thiourea@30ppm, T_4(16.63mm) i.e.,thiourea@10ppm, T_8(16.60mm) i.e.,vermiwash@100%, T_9(15.88mm) i.e.,vermiwash@50% and T_5(15.80mm) i.e.,thiourea@20ppm. Treatment T_{10} (7.20mm) i.e., control, recorded the minimum average bulb length. The maximum average breadth of the bulb recorded in treatment T_2 (15.46mm), i.e.,thiourea@20ppm, which was at par with treatments T_6 (14.82mm) i.e.,thiourea@30ppm, T_8 (13.63mm) i.e.,vermiwash@100% and T_7 (13.35mm) i.e., cow urine @10%. In contrast, the minimum average length of the shoot recorded in treatment T_{10} (6.76mm) i.e., control.

Seeing the data, the application of paclobutrazol resulted in the maximum length and breadth of bulbs, thiourea and vermiwash had at-par results with paclobutrazol. Applications of different growth substances and bio enhancers may have affected the bulb length and breadth. Using growth retardants like paclobutrazol increased the carbohydrate accumulation in the bulbs, increasing the bulb's length and breadth. Zheng *et al.* (2012) (16) supported these findings.

The differences may also be due to the use of thiourea, cow urine as urea, and its derivatives also stimulate the weight of bulbs found by Kumar *et al.* (2007) (9). Similar findings were in Gladiolus, where the size of cormels per plant was maximum with GA3 150 ppm, SA 150 ppm and thiourea 2%, as observed by Padmalatha*et al.*, 2012. Chattopadhyay *et al.* (2015) (3) also reported that using thiourea increased the bulb size in garlic.

Effect of different treatments on the average value of root length (cm) and shoot length (cm) after 30, 60 and 90 days after spraying of treatments.

According to statistical analysis, data in Table 1 for the effect of different treatments on the average length of root and shoot of microbulblet after 30 days of the spray of treatments was non-significant and significant, respectively. The maximum and minimum average root length after 30 days was in treatments T_6 (4.87cm) i.e.,thiourea@30ppm and T_2 (2.00cm) i.e.,paclobutrazol@20ppm, respectively. Treatment T_5 (4.88cm), i.e.,thiourea@20ppm, showed the maximum average length of the shoot, which was to be at par with treatments T_{10}(4.34cm) i.e., control, T_2(3.94cm) i.e.,paclobutrazol @20ppm and T_8(3.76cm) i.e.,vermiwash@100%. Treatment T_3 (3.33cm) i.e.,paclobutrazol @30ppm,

showed the minimum average length of the shoot, which was to be at par with T_{10}(3.34cm) i.e., control, T_2(3.94cm) i.e.,paclobutrazol @20ppm T_8(3.76cm) i.e.,vermiwash@100% and T_1(3.60cm) i.e.,paclobutrazol @10ppm.

The effects of different treatments after 60 days of the spray of treatments on the average root length and shoot length are depicted in table 2. The observations were found non-significant for root length, and shoot length was recorded to be highly significant. The maximum and minimum average root length was given by treatments T_5 (6.63cm) i.e.,thiourea @20ppm and T_3 (3.07cm) i.e.,paclobutrazol@30ppm, respectively. The maximum average length of the shoot was recorded in treatment T_9 (15.44cm), i.e.,vermiwash@50%, which was at par with treatments T_7(14.26cm), i.e.,cow urine @10%, T_6(12.85cm) i.e.,thiourea@30ppm and T_5(11.63cm) i.e.,thiourea@20ppm and the minimum average length of the shoot was recorded in treatment T1 (4.62cm) i.e.,paclobutrazol @10ppm which was at par with treatments T_3(7.55cm) i.e.,paclobutrazol @30ppm, T_{10}(7.23cm) i.e., control and T_2(5.63cm) i.e.,paclobutrazol @20ppm.

Observation made in table 3 on the effect of different treatments on the average length of root and shoot on the 90th day of the experiment was found significant. The minimum length (2.43 cm) wasrecorded in T_5 (thiourea - 20ppm), which was at par with T_4 (thiourea@10ppm) (4.83cm), T_6 (thiourea @30ppm) i.e.,4.80cm, T_2 (paclobutrazol 20ppm) i.e.,, 3.78cm, T_3 (paclobutrazol 30ppm) i.e.,,3.38cm, T_1 (paclobutrazol @10ppm) i.e.,2.80cm and T_{10} (control) i.e.,2.80cm. The maximum average length of the root was in T_8 (vermiwash@100%) i.e., 7.70cm, which was at par with treatments T_9 (vermiwash@50%,) i.e.,,6.33cm, T_7 (cow urine @10%,) i.e.,6.08cm T_4 (thiourea - 10ppm) i.e.,4.83cm and T_6 (thiourea@30ppm.) i.e.,4.80cm. The maximum average shoot length was recorded in treatment T_6 (thiourea@30ppm) i.e.,17.38cm which was found at par with treatments T_7(cow urine @10%) i.e.,15.56cm, T_8(vermiwash @100%) i.e.,15.42cm), T_5(thiourea@20ppm) i.e.,14.70cm, T_9(vermiwash @50%,)i.e.,13.38cm, T_4(thiourea@10ppm) i.e.,13.00cm and T_3(paclobutrazol@30ppm) i.e.,12.33cm and the minimum average shoot length was recorded in T_1(paclobutrazol@10ppm)i.e.,7.45cm which was found to be at par with treatments T_2(paclobutrazol@20ppm) i.e.,9.00cm and T_{10}(control) i.e.,8.84cm. The shortest root and shoot length recorded at treatments treated with paclobutrazol 10, 20 and 30 ppm.

The reason may be because of paclobutrazol, which is a growth retardant. In paclobutrazol-treated plants, stem length decreased, as found by Zheng *et al.*, 2012[16].Francescangeli (2010) [5] got similar findings in Iris production. Treatments like thiourea 10, 20 and 30 ppm and cow urine 10 ppm produced long root and shot length,

possibly because of nitrogenous substances, which is a growth booster. Also, according to Kumar *et al.,* 2007[9], all levels of urea and thiourea produced leafy bulblets. Treatments treated with vermiwash also gave good root and shoot length as auxin is present in vermiwash, promoting root development.

Conclusion

From the findings, the effect of plant growth substances and bio-enhancers on the production of bulbs from micro bulblets showed great potential with treatment like paclobutrazol, leading to the enhancement of bulbs. However, using organic growth substances and bio-enhancers like vermiwash (100% and 50%) and cow urea (10%) was at par with paclobutrazol.

From the study, we can conclude that the organic growth substances and bio-enhancers can substitute for chemical growth substances in the production of bulbs in Lilium in vivo conditions.

Comment [A9]: Very weak and general but not gave a specific recommendation to the farmers or scientific community

Table 1.Effect of different treatments on the average value of carbohydrate content (mg/g), chlorophyll content (ug/ml), moisture content (%), bulb weight (g), bulb length (mm), bulb breadth (mm), root length (cm) and shoot length (cm)h after 30 days of the spray of treatments

Comment [A10]: Too long caption
I recommend that Tables could be reconstructed as:
Carbohydrate, chlorophyll and moisture content in one Table under 30, 60 and 90 days to compare the intervals effects
Collect growth traits in one Table under 30, 60 and 90 days also

Treatments	Carbohydrate content (mg/g)	Chlorophyll Content (ug/ml)	Moisture Content (%)	Bulb Weight (gm)	Bulb Length (mm)	Bulb Breadth (mm)	Root Length (cm)	Shoot Length (cm)
T_1	27.57	4.62	86.97	0.67	16.19	11.41	3.50	3.60
T_2	44.85	4.87	88.50	0.47	12.82	9.78	2.00	3.94
T_3	25.35	4.58	79.56	0.58	14.04	10.44	2.50	3.33
T_4	45.74	8.48	83.67	0.40	12.07	9.20	4.25	4.87
T_5	43.96	7.03	81.21	0.28	11.46	8.55	4.75	4.88
T_6	62.57	8.44	80.37	0.25	9.95	7.49	4.87	5.19
T_7	50.61	6.06	76.33	0.36	11.18	8.69	4.23	5.22
T_8	49.73	5.48	82.37	0.29	11.27	8.43	4.48	3.76
T_9	16.94	9.34	79.50	0.46	11.05	9.42	3.88	5.02
T_{10}	24.89	6.00	85.76	0.16	9.15	6.47	3.58	4.34

SE(m)±	11.007	0.495	2.925	0.974	1.117	0.596	0.952	0.399
CD@5%	NS	******1.462	NS	*0.287	*3.295	****** 1.760	NS	* 1.179

NS – Non-significant, * - Significant and ** - Highly significant

Table 2. Effect of different treatments on the average value of carbohydrate content (mg/g), chlorophyll content(ug/ml), moisture content(%), bulb weight(gm), bulb length(mm), bulb breadth(mm), root length(cm) and shoot length(cm) after 60 days of a spray of treatments.

Treatment	Carbohydrate concentration (mg/g)	Chlorophyll Content (ug/ml)	Moisture Content (%)	Bulb Weight (gm)	Bulb Length (mm)	Bulb Breadth (mm)	Root Length (cm)	Shoot Length (cm)
T_1	62.57	4.14	71.8	0.88	18.13	12.77	3.65	4.62
T_2	24.47	3.82	75.74	0.59	14.75	10.76	3.32	5.63
T_3	43.08	4.18	65.49	0.67	14.07	11.54	3.07	7.55
T_4	76.31	8.96	71.69	0.31	11.72	8.65	4.00	9.81
T_5	72.77	6.09	72.95	0.35	11.19	9.20	6.63	11.63
T_6	56.81	8.39	70.45	0.59	14.40	11.3	4.73	12.85
T_7	65.23	4.66	66.79	0.41	13.09	9.52	5.55	14.26
T_8	71.44	4.57	51.78	0.40	12.16	9.20	5.38	10.90
T_9	40.86	10.12	64.56	0.36	12.08	9.06	5.13	15.44
T_{10}	22.69	6.99	71.21	0.23	10.16	7.34	5.49	7.23
SE(m)±	10.669	0.686	3.890	0.759	0.926	0.635	0.892	1.329
CD@5%	*****31.475	******2.026	*11.476	**0.223	**2.734	******1.875	NS	**3.920

NS – Non-significant, * - Significant and ** - Highly significant

Table 3. Effect of different treatments on average value of carbohydrate content (mg/g) , chlorophyll content(ug/ml), moisture content(%), bulb weight(gm), bulb length(mm), bulb breadth(mm), root length(cm)and shoot length(cm) after 90 days of spray of treatments

Treatments	Carbohydrate content (mg/g)	Chlorophyll Content(ug/ml)	Moisture Content (%)	Bulb Weight (g)	Bulb Length (mm)	Bulb Breadth (mm)	Root Length (cm)	Shoot Length (cm)
T_1	62.13	3.06	55.88	0.43	13.21	10.66	2.80	7.45
T_2	60.36	3.42	60.28	1.27	20.01	15.46	3.78	9.00
T_3	58.14	3.33	59.58	0.86	14.13	12.47	3.38	12.33
T_4	70.11	2.55	65.76	0.97	16.63	12.71	4.83	13.00
T_5	61.24	2.67	64.09	0.69	15.80	12.20	2.43	14.70
T_6	72.77	3.01	58.10	1.38	17.45	14.82	4.80	17.38
T_7	78.97	3.37	59.58	0.94	15.25	13.35	6.08	15.56
T_8	73.21	3.12	58.09	0.96	16.60	13.63	7.70	15.42
T_9	65.23	3.16	63.91	0.92	15.88	11.19	6.33	13.48
T_{10}	47.95	4.00	43.20	0.19	7.20	6.76	2.80	8.84
SE(m)±	7.986	0.384	3.554	0.163	1.500	0.944	0.990	1.856
CD@5%	NS	NS	*10.486	**0.481	**4.427	**2.785	*2.920	*5.477

NS – Non-significant, * - Significant and ** - Highly significant

Paclobutrazol@10ppmPaclobutrazol@20ppm Paclobutrazol@30ppm

Thiourea@10ppm Thiourea@20ppm. Thiourea@30ppm

Vermiwash@100 %. Vermiwash@50 %

Cow urine @10%

Control

Comment [A11]: Figure is not clear enough therefor it could be excluded

Fig 1: Enhancement of bulblets with effect of different treatments.

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Comment [A12]: More attention should be paid for reference list to be compatible with those mentioned in the text
Recent and more related references are urgently needed

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Comment [A13]: Zhing or Zheng !!