

[Article ID : 01/II/06/0121]

INHIBITORY EFFECT OF AUXIN ON CORM MEDIATED EMERGENCE IN YACON (*SMALLANTHUS SONCHIFOLIUS*)

Bablu Paul¹, Moumita Mallick¹ and Hossain Ali Mondal^{1*}

¹Discipline of Genetics and Plant Breeding, Uttar Banga Krishi Viswavidyalaya,
Cooch Behar-736165, West Bengal, India

*Present address-

School of Crop Improvement (SCI), College of Post Graduate Studies in Agricultural Sciences
(CPGS-AS), Umiam, Meghalaya-793 103.

Central Agricultural University, Imphal, Manipur.

E-mail: mondal.cpgs.cau@gmail.com;

*Orcid id- <http://Orcid.org/0000-0001-5181-0300> (HAM)

Abstract

The yacon (*Smallanthus sonchifolius*) tuber is enriched with metabolite, fructo-oligosaccharides (FOS) having proven health benefits. The FOS has multi health benefit effect on reducing glycemic index, body weight, the risk of colon cancer, blood sugar levels, cholesterol level. It was also proved that FOS boosted-up immune system as well as weight loss. The quality planting material production (QPM) from tuber corm is very common practice. For the first time, it is being reported that 0.477 ± 0.033 g corm will potentially give new emergence in the formulated artificial soil under controlled environment. Further, it was revealed that auxin inhibited leaf development recorded at 14 days. Characteristically, root diameter was higher in auxin treated corm. Auxin did not have any effect on 'total weight', 'number of roots' and 'highest root length' at 14 days. But there is no significant difference in 'total weight', 'total plant height', 'number of roots', 'highest root length' and 'root diameter' at 28 days. Characteristically, there was no initiation of leaf in auxin treated corm at 28 days, hence number of leaves, leaf length and leaf breadth were higher in auxin untreated corm. In conclusion, auxin showed inhibitory effect on initiation of emergence. Therefore, auxin is not recommended for corm treatment for new emergence in formulated artificial soil under controlled environment on smaller sized corm having average weight of 0.477 ± 0.033 g.

Key words : *Smallanthus sonchifolius*; Corm; Quality planting material (QPM); Above ground and below ground character.

Introduction

Yacon (*Smallanthus sonchifolius*) have high medicinal merit for the diabetic patients. This crop is cultivated in Hill zone and availability of the rhizome is very much limited. Moreover, the price of yacon rhizome is very high throughout the year. Yacon (*Smallanthus sonchifolius*) is a perennial herbaceous plant belongs to the family Asteraceae with having a medicinal value in tuber. The below ground tuber is enriched with fructo-oligosaccharides (FOS) which constituted 6.4% to 70% of the dry matter and 0.7% to 13.2% of the fresh weight. The FOS is an excellent health benefits like reduced glycemic index, body weight, the risk of colon cancer, the control of blood sugar levels, control of cholesterol level, boosting immune system and helping in weight loss. With the increasing demand for quality planting material (QPM) in the market due to its medicinal properties, farmers demand for sufficient QPM. Normally, yacon was conventionally propagated by the propagating roots (corms). The reduced flowering emergence as well as subsequent fruit set in the cultivated yacon were common problem in cultivated *Smallanthus* species (Leon., 1964). Moreover, high proportion of the seeds were also non-viable and/or low vigor. Aerial stem cuttings were also



reported for its propagation conditioned with desiccation protection (Robinson, 1978; Castañeto and Inhumang, 2004). But this process needs the destruction of the mother plant. As alternative for multiplication and maintenance of germplasm of this species, efficient techniques have already been reported (Corrêa et al., 2009). Direct organogenesis from stem cuttings and leaf segments had been reported as a tool for germplasm conservation (Estrella and Lazart, 1994; Niwa, 2002). Even, somatic embryogenesis was also reported in this species (Corrêa et al., 2009). The present research takes an attempt for auxin treatment in corm to evaluate the early time point below and above ground growth benefit.

Fructooligosaccharides (FOS) are fructans consisting of linear short chains of fructose molecules. Fructans are synthesized from sucrose in the cell vacuoles of plant leaves, stems and roots. They help protect against drying out and are carbohydrate reserves in a wide number of plant families. FOS are natural food components that can be found in garlic, onion, asparagus, artichoke, banana, wheat and yacon. However, the highest concentrations of FOS are found in yacon. FOS are able to escape enzymatic digestion in the upper gastrointestinal tract, reaching the colon intact before undergoing microbial fermentation. FOS intake elicits a bifidogenic effect by selectively stimulating the proliferation of *Bifidobacteria*, a group of beneficial bacteria naturally found in the human colon. Short chain fatty acids (SCFA), the end products of FOS fermentation by the intestinal microbiota, can also favour the growth of health-promoting bacteria such as *Bifidobacterium spp.* and *Lactobacillus spp.*, while reducing or maintaining pathogenic populations (e.g., *Clostridium spp.* and *Escherichia coli*) at low levels. Thus, FOS are small soluble dietary fibres that exhibit prebiotic activity.

In the present research, the effect of auxin was evaluated in the corm at the early time point below and above ground growth benefit in the formulated artificial soil under controlled environment.

Material and methods

Field experimental location and mother plant

The yacon corm was collected and experiment was performed in the controlled environment located at 28°19'N latitude and 89°23'E longitude and at an altitude of 43 m above the mean sea level.

Artificial soil formulation

Artificial soil (AS) was formulated with perlite, peat moss and vermiculite (1:1:1). Perlite was reported for maintaining aeration to ensure an excellent air/water balance which impact on better root growth including better uptake of nutrients in more effective manner. Peat Moss retained moisture for better plant growth which also saves irrigation frequency. Moreover, releases of water and nutrients to the right proportions for optimum plant growth of plant, and reduce the application of manuring. Vermiculite was reported to improve soil porosity as well as act as a medium for water and nutrient Exchange. The water soluble NPK (20:20:20) @1g per liter of water, PSB and Tricoderma power @5g (2.5g+2.5g each) per 100 ml were used for irrigation in artificial soil for 2 kg. Both PSB and *Tricoderma* power were used only once. This AS was known as supplemented artificial soil (SAS).

Treatment of axial bud

The collected corm was cut and touched with auxin enriched power (cutting aid).

The controlled environment for emergence

The initial environmental incubation was very crucial for new plant emergence. The transparent box with tight lid was used for maintaining the humidity. The pot was filled with SAS and kept in



transparent box which was again incubated in the environment of 6000 LUX light intensity, 14-hour light condition per day, 70% of Relative Humidity in PGR.

Statistics

One-way ANOVA and Tukey's HSD Calculator was used for calculation (<https://www.icalcu.com/stat/anova-tukey-hsd-calculator.html>) to calculate p values at 0.05% level of significance to see any significant difference. The MedCalc statistical software (https://www.medcalc.org/calc/comparison_of_means.php) was also explored to calculate the difference between the observed means in two independent samples.

Discussion

The cutting aid was enriched with IBA, NAA, PHB, H₃BO₃, Vitamin, Surfactant, Talc powder. The direct power enriched with auxin was used for the study for evaluating effect on corm on early time point emergence growth. Yacón, *Smallanthus sonchifolius* was originated from the mountain regions of South America. This plant categorized as a perennial herb, attained height of 2 to 2.5 m tall with a root system composed of 4 to 20 edible fleshy tuberous storage roots (Zardini, 1991). In addition to enrichment of fructo-oligosaccharides, the tuber was an excellent source of low energy (Aybar et al., 2001). Aybar et al. (2001) demonstrated that the hypoglycemic effect of the aqueous extract of yacón leaves in diabetic rats evidenced an increase in the concentration of plasma insulin. Recently, analysis of the leaf and tuber extracts showed that both parts of the yacón plant represented a rich source of phenolic acids suggesting antioxidant proprieties (Valentova et al., 2005).

This is the first-time report that new plant emergence was recorded from 0.477±0.033g corm in the formulated artificial soil under controlled environment (**Fig. 1**). The auxin treated corm behaved differentially in the above ground growth in artificial soil under controlled environment. The growth snapshot was recorded at 14 days (**Fig. 1**). The cutting aid, enriched with auxin was used for treatment.



Figure 1

To evaluating the below ground characters, all corm was removed from artificial soil at 14 days and snapshotted (**Fig. 2**). From the result, it was revealed that root development was recorded even



when no leaf initiation was evidenced (**Fig. 2**). Therefore, corm reacted differentially in the above ground characters only, not below ground characters in the artificial soil under controlled environment (**Fig. 2**).

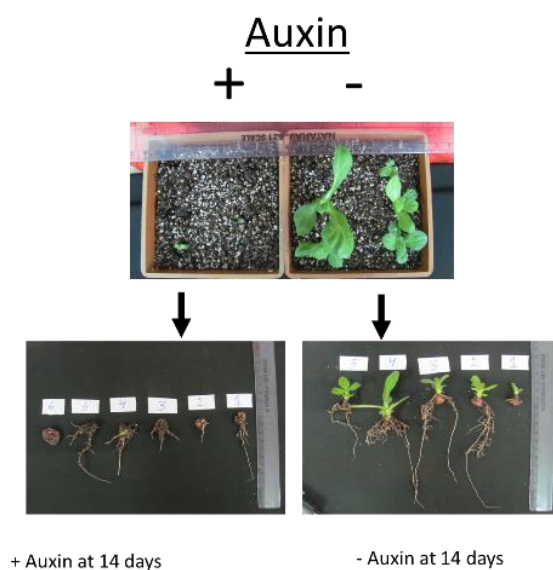
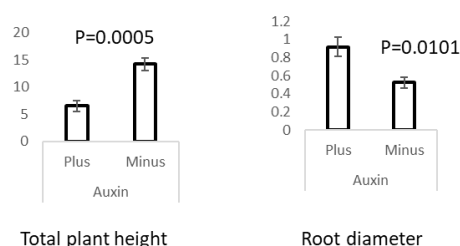


Figure 2

The above and below ground growth record at 14 days in auxin treated corm is recorded (**Fig. 3**). The result showed that significant difference was recorded in 'total plant height', and 'root diameter' (**Fig. 3**). As the new leaf was initiated in auxin untreated corm, the plant was higher as compared to auxin treated corm when no leaf initiation was recorded (**Fig. 3**). Hence, the leaf development was recorded in auxin untreated corm, the number of leaf emergence, leaf length and leaf diameter were higher in auxin untreated corm (**Fig. 3**). Curiously, the root diameter was higher in auxin treated corm (**Fig. 3**).



Significant difference at 14 days in

- i) Total height
- ii) Root diameter
- iii) Number of leaf
- iv) Leaf length
- v) Leaf breadth

Non-significant difference at 14 days in

- i) Total weight
- ii) No. of root
- iii) Highest root length

Figure 3



Figure 4

Corm mediated emergence was snapshotted at 28 days to evaluate above and below ground characters (**Fig. 4**). From the experiment, it was revealed that both have root initiation but auxin untreated corm showed only leaf emergence and development (**Fig. 4**).

The statistical analysis revealed that 'total weight', 'total plant height', 'number of roots', 'highest root length' and 'root diameter' were not significant (**Fig. 5**). Interestingly, there was no emergence in leaf initiation at 28 days (**Fig. 5**). Naturally, number of leaves, leaf length and leaf breadth were higher in auxin untreated corm (**Fig. 5**).

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|--|--|
| <p>Significant difference in</p> <ul style="list-style-type: none"> i) Number of leaf ii) Leaf length iii) Leaf breadth | <p>Non-significant difference in</p> <ul style="list-style-type: none"> i) Total weight ii) Total plant height iii) Number of root iv) Highest root length v) Root diameter |
|--|--|

Figure 5

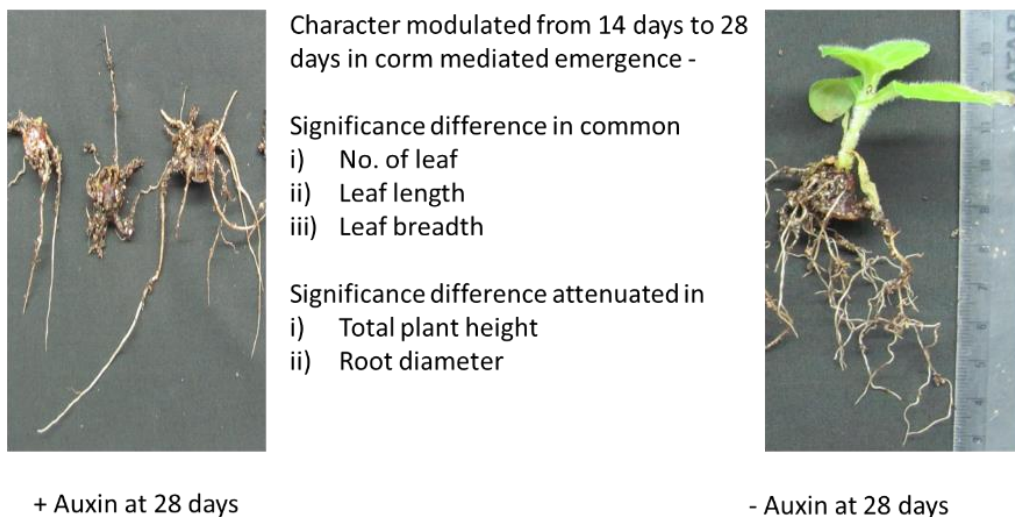


Figure 6

In summary, it was found that no leaf emergence was developed at 28 days. Therefore, from 14 days to 28 days, only 'number of leaf', 'leaf length' and 'leaf breadth' were increased (**Fig. 6**). Interestingly, the characters like 'total plant height' and 'root diameter' were significant at 14 days



time point but significance difference was attenuated in 28 days. Moreover, the characters like 'total weight', 'total plant height', 'number of roots', and 'highest root length' were not significantly different (Fig. 6). The summary of the result showed that auxin inhibited only in leaf emergence but not in the below ground characters (Fig. 6).

Author contribution statement

HAM conceptualized the idea, performed the experiment and wrote the manuscript. BP and MM performed experiments.

Acknowledgement

The communicating author (HAM) acknowledged sincerely to NMPB, Ministry of AYUSH for the financial support (Grand Number-Z.18017/187/CSS/R&D/WB-1/2016-17-NMPB-IVA, Dated: 05.08.2016) and DST, India for the financial support for DST-SERB project (Grand Number-ECR/2015/000184) as Early Career Research Award to HAM.

Compliance with ethical standards (e.g. Conflict of interest)

The communicating author (HAM) declared that there is no conflict of interest.

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