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R&D OF A NEW SEEDLING SUBSTRATE OF JOINT UNIT OF COMPRESSING INTEGRAL SUBSTRATE (JUCIS) IN CHINA

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SUMMARY

A new peat product of Joint Unit of Compressing Integral Substrate (JUCIS) made of fen peat has been studied and industrially developed following development of the single unit of Compressing Integral Substrate (CIS) in China. A large scale production line has been established in Northeast China. The benefit of the new product has been proven in the Chinese market. The JUCIS is manufactured by linking over 20 units of single CIS into a joint unit product at the tangent point amongst CIS by using a special model and hydro press. Comparing with the CIS, three improvements have been made: 1) JUCIS can easily be produced industrially by standardization and automation; dust emissions during production are prevented; labor and product costs have been decreased by 79% and 30%, respectively. 2) Spacing of nursery seedlings can be reduced; water evaporation from the substrate decreases by 35%, and temperature of the substrate has been increased by 2-4 ℃ which prevents temperature fluctuation of the seedling during different cultivation seasons. 3) JUCIS is easy to be packed, transported and used. Productivity of seedling nurseries can be increased up to 42% and labor costs can be decreased by 23%.The JUCIS can be separated as single units before transplantation.

KEYWORDS: JUCIS, seedlings, fen-peat

INTRODUCTION

Jiffy pellets are well known and sold worldwide. However, Jiffy pellets are manufactured from *Sphagnum* peat and are net-covered. The high price of the product has narrowed its market in spite of applications in forestry and the hobby market. China is an agricultural country with a huge demand for vegetable seedling. The low cost of seedling cultivation cannot support the high price of Jiffy pellets. At the same time China is rich in fen peat but poor in *Sphagnum* peat; it is impossible to produce and supply Jiffy pellets in China. In order to meet the demand of vegetable seedling cultivation, we have developed the so-called Compressed Integration Substrate (CIS) in 1999 with Chinese fen peat. The product is manufactured from fen peat without net-coverage. The price of the CIS product is so low that

the vegetable can afford it. The admixed nutrients can support seedling growth for ca. 80 days. Today, CIS is sold throughout China.

However, there are still some problems related to CIS that need to be solved: CIS is a single unit, the product is difficult to produce automatically and production costs cannot easily be decreased due to labor cost. In addition, labor costs increase, because CIS pellets must be set onto cultivation tables in the greenhouse one by one by hand, increasing the need for space. The temperature and moisture content of CIS are difficult to maintain, because the substrate is completely exposed. The purpose of this project is to develop a new product that can be produced automatically with lower cost. In particular, the high water evaporation should be decreased and the fluctuation of product temperature should be limited.

MATERIALS AND METHOD

Fen peat of Northeast China is chosen as the raw material for JUCIS. The peat organic matter is >60%, humic acid is >30%, decomposition degree is <40%, Von Post degree of humification is H4-6, pH is 5.5-6.5. All peat samples are sun-dried and loosened by machine. Some additives are admixed to supply nutrients and promote the expansion of the product after watering.

A hydraulic press of 100 tons pressure (with two fuel tanks) was used in the experimental phase of JUCIS production. A mobile hopper is used to feed the raw material into the model. All raw materials and products are transferred by the belt. A mixing machine is employed for mixing the fen peat and other necessary components. The products are packaged with hot shrink film and carton.

The strength, expansion rate of the pellets after watering and the chemical properties of JUCIS where determined. The performance of seedlings, biological productivity and change of temperature and moisture content of JUCIS were recorded during seedling growth. The productivity of JUCIS per worker, electricity cost, labor cost and other production indicators were monitored.

RESULTS AND DISCUSSION

Productivity and cost of product

The joint unit model has made the automatically feeding of raw material possible due to the larger opening of the model than that of the single model. All action including force shifting down, pressing, force shifting up, negative mode shifting up to crest the product out of the model, removing the product and feeding the raw material again, etc. are all computer-controlled. Therefore, an automatic

production line was set up in the JunoScience Company with belt conveyors, automatic weighing machines, double-shaft mixing machine, JUCIS automatic molding machine and heat shrinkable packaging machine.

The new production line has increased the productivity per day from 512 cartons of single unit product to 576 cartons of the joint unit product. That reduces electricity costs per carton from 0.175RMB to 0.156RMB and the overall labor productivity increases from 746.7RMB to 4032RMB. The number of workers needed for each modeling machine has decreased from 3 to 0.65 persons, reducing labor costs per carton from 2.25 RMB to 0.417 RMB.

Table 1. Comparison of the productivity and costs between two product modules.

Product types	Productivity per day	Electricity costs	Number of workers	Overall labor productivity	Labor cost per carton	Electricity costs per carton
Joint-unit	576	89.6	5	4032	0.417	0.156
Single unit	512	89.6	24	746.7	2.25	0.175

Application of the JUCIS

Productivity of seedling cultivation is significantly increased when using JUCIS instead of CIS. 9000 joint units can be set in one hour but only 720 single units can be set in the same time. Only 0.33 workers are needed to set 3000 JUCIS units compared to 4.16 workers for the same number units when using CIS. That means the labor cost is only 2 RMB when using JUCIS compared to 25 RMB for CIS.

JUCIS saves space: 370 units per m² can be set compared to just 238 units/m² when applying CIS, saving ca. 35.6% of the space.

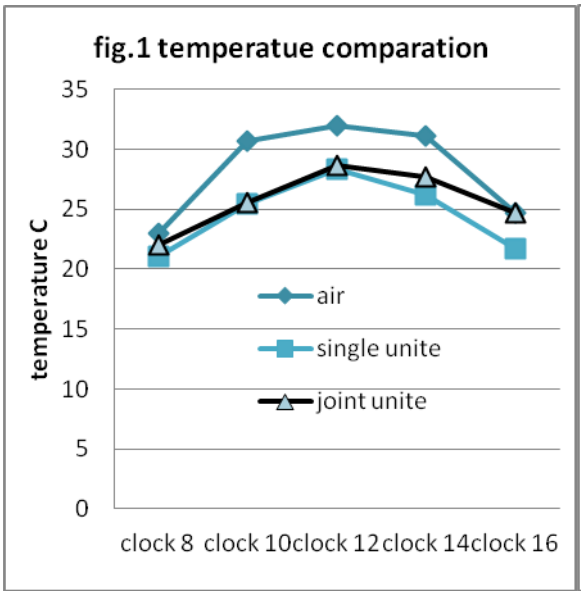
Tab. 2, Comparison of labor cost and space saving

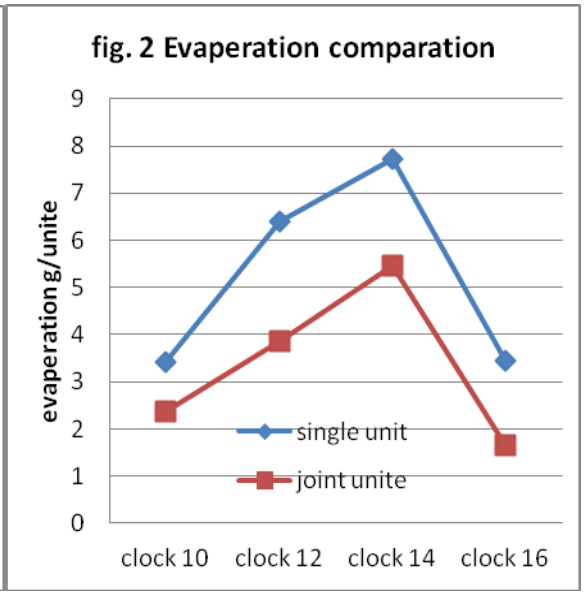
Product type	Setting number per hour	Workers needed for 3000 seedings	Labor cost	Number per meter	Area per 3000 seedlings
Joint unit	9,000	0.33	2	370	8.1
Single unit	720	4.16	25	238	12.6

Temperature maintains and water conservation of JUCIS

JUCIS is able to increase the temperature of the substrate and is good for seedling growth, especially in winter and the early spring season. The temperature in the JUCIS is 1℃ higher in the morning and 2 ℃ higher during the afternoon compared to the temperatures measured in CIS units. At noon temperatures hardly differ.

JUCIS also decreases the water evaporation of the substrate which improves water retention of the product and lengthens irrigation intervals. Evaporation is decreased by 24 g of water /day compared to CIS.





Benefit of JUCIS application

Promotion of JUCIS has been conducted throughout China for one year. Users have recognized its simple, rapid, economical and easy use advantages. Due to the improved temperature regime and water retention of the product, JUCIS has remarkably improved the performance of seedlings. The balanced nutrition has promoted flowering after transplanting into the field. When the root tips points grow out of JUCIS, the root tips break/die by air or sunshine so that more hair roots grow, which improves uptake of water and nutrients from soil.

Compared to CIS the performance of seedlings in JUCIS pellets is improved after transplanting to the field. 60% of a flowering crop flowered 3-5 days earlier than plants cultivated in CIS (Tab. 3). Harvest is earlier resulting in price increases for fruits, vegetables and flowers. The number of cucumber per stem of JUCIS was increased 16% and average weight has increased 13.9% comparing to CIS-grown crops. The productivity of cucumber with JUCIS seedlings increased by 21.3% and the harvest increased by26.1%.

Tab. 3. Benefit of JUCIS application comparing to CIS.

Indicator	Joint unite	Single unite	%
flowering（60%）	Sep.16	Sep.19	3-5days ahead
harvest（60%）	Oct.16	Oct.24	7-10days ahead
Cucumber num ber stem	7.25	6.25	16.0
Average weight (g）	213	187	13.90
productivity（kg/666m^2）	4691	3867	21.30
output（RMB/666m^2）	12196.6	9669.5	26.1%

JUCIS is a new product based on the Compressed Integration Substrate (CIS). It is easy to manufacture automatically. Labor costs can be reduced remarkably; water and temperature regimes are much better compared to those of CIS. It is valuable to use JUCIS as seedling substrate, due to the good performance of the seedling and of the crop after transplanting into the field.

REFERENCES

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