

Study on Germination of Komatsuna Seed in Hydroponics Culture Using Urethane Mat

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Abstract

A study was conducted to determine the effect of planting depth on the germination of komatsuna (salad vegetable) in hydroponics culture using urethane mat. Experiments used 8 planting depths, they were at mat's surface, half of seed's thickness, 0, 1, 2, 3, 4 and 5 mm. Germination experiment at each planting depth was replicated 3 times. The experimental results showed that the germination rate decreased as the planting depth increased. The germination rates of 97.2, 95.4, 91.6, 92.6, 91.7, 92.6, 90.7 and 83.3 % were recorded at the planting depths of mat's surface, half of seed's thickness, 0, 1, 2, 3, 4 and 5 mm, respectively. At the planting depths of mat's surface the komatsuna seed had relatively high germination rate but the seedling's root did not firmly and deeply penetrated into the urethane mat. From the point of view of mechanization of planting vegetable seed using hydroponics, the planting depths from more than half of seed's thickness to 4 mm were useful for providing the komatsuna seedlings the best germination and growth in the hydroponics urethane mat. This finding can be used as design parameter for the development of an automatic seeding mechanism for hydroponics culture using urethane mat.

Key words : Hydroponics, Germination, Komatsuna, Urethane mat, Planting mechanism

I INTRODUCTION

Planting depth is important factor determining the vegetable seedling emergency¹⁾ and thus maintaining the proper planting depth will provide good germination and growth of vegetable seedling in hydroponics vegetable production.

In general most of the vegetable seed should be covered about twice its greatest diameter deep²⁾.

The urethane mat has recently used in hydroponics vegetable production and there is a need to investigate the planting depth requirement in the urethane mat.

The objective of this research is to determine the proper planting depth good for komatsuna seedling germination and to use the determined planting depth as a design parameter for the development of an automatic seeding mechanism for hydroponics komatsuna.

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II MATERIALS AND METHOD

1. The experimental set up

The experimental set up is shown in Fig.1. The commercialized vacuum seeder (Agritecno Yazaki Co. SHH-100) was used as a basic set up, the seed punching mechanism was developed and attached to the basic set up in order to deposit the vegetable seeds into the commercial urethane mat.

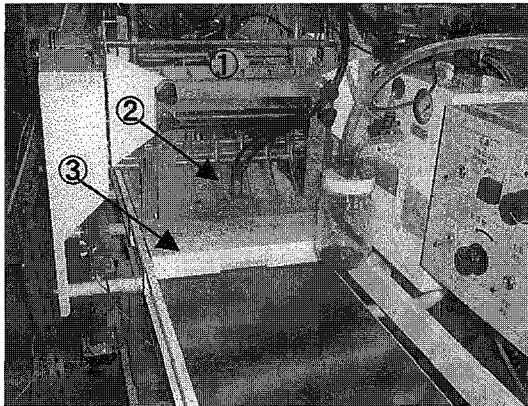
2. The seed punching mechanism

The schematic diagram of seed punching mechanism is shown in Fig.2. The seed punching mechanism consists of puncher-heads with inner diameter of 3 mm. The design of the

puncher-head is shown in Fig.3. A double action air cylinder actuated the puncher-heads and the movement of the puncher-head into the urethane mat is shown in Fig.4. Before punching down into the urethane mat, the puncher-heads are placed up to the urethane mat's cell (Fig.4, a) at the adjustable height of from 0 to 10 mm. The puncher-heads are automatically punched down to the urethane mat's cells at pre-determined planting depths and stayed inside the urethane mat (Fig.4, b) for a certain time. Thus to allow the picked up seeds after discharging from the suction nozzles be dropped through the puncher-heads, and then entered the into urethane mat's cells at above-mentioned desired pre-determined planting depths (Fig.4, c).

3. Experimental procedure

Twenty marketed trays with the foam urethane mats (sizes $W300 \times L600 \times H30$ mm, weight of 102 g) of Mikado Seed Grower Co. were employed for germination experiments. The salad vegetable seed used for planting into urethane mat was *Maruha* komatsuna seed variety with recommended germination rate of 95 %. The komatsuna seed's sizes are shown in table 1. The urethane mats were moistened with tap water of 3.5 liters per tray. The seed punching mechanism was set to deposit single seed of komatsuna per cell (total 78 seeds per urethane



1. Conventional vacuum seeder
2. Seed punching mechanism
3. Seedling urethane mat
Fig. 1. Experimental set up

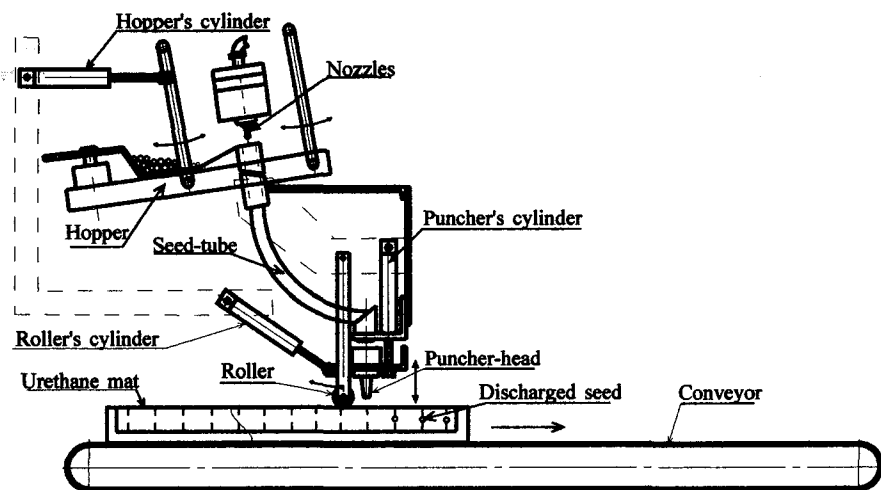


Fig. 2. Schematic diagram of seed punching mechanism

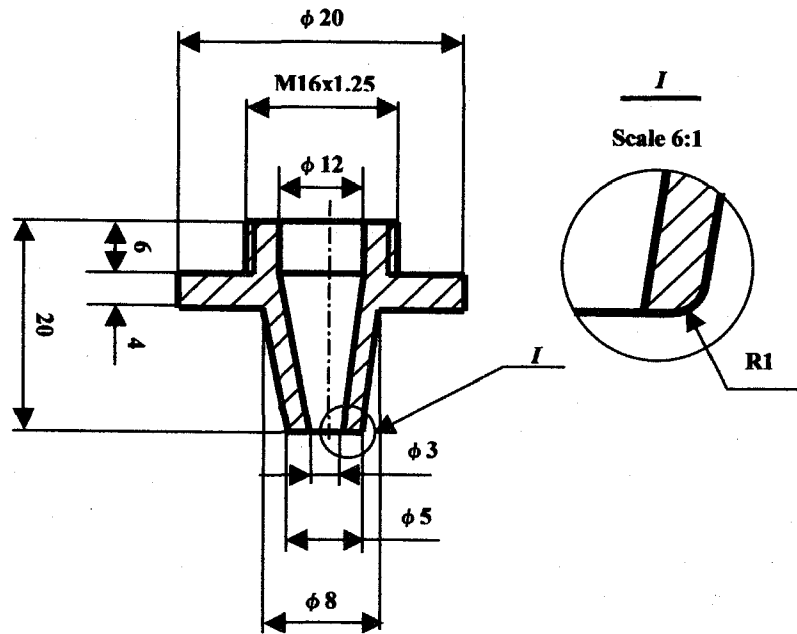


Fig. 3. Design of the puncher-head

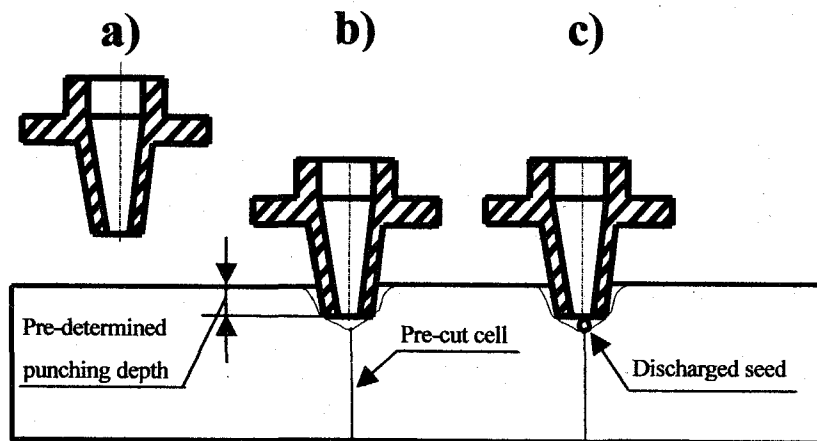


Fig. 4 Puncher-head's movement urethane mat's cells

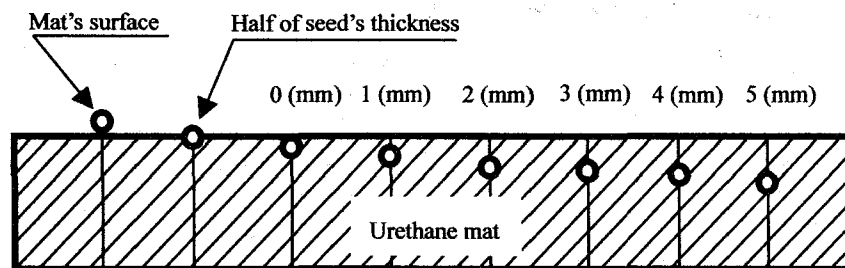


Fig. 5. Komatsuna seeds deposited at different planting depth

mat). The puncher-heads were set at the planting depth of mat's surface, half seed's thickness, 0, 1, 2, 3, 4 and 5 mm. The komatsuna seeds placed at different planting depth are shown in Fig. 5. The germination experiments were last

for 7 days and repeated 3 times. The experiments were conducted in the closed room with the average temperature of 28 °C, the air humidity of 80 %, and the light intensity of 0.75 Klux. Only the planted urethane mats with a planting

rate of 100 % were used for germination experiment.

The germination of the deposited seed inside every pre-cut cell was examined and counted in order to evaluate the komatsuna's germination rate at different planting depth.

III RESULTS AND DISCUSIONS

The results showed that the germination rate decreased as the planting depth increased, and the komatsuna seed has the germination rate of 97.2, 95.4, 91.6, 92.6, 91.7, 92.6, 90.7 and 83.3 % at the planting depth of mat's surface, half seed's thickness, 0, 1, 2, 3, 4 and 5 mm respectively. The results of germination experiments are shown in Fig. 6.

At the planting depth of mat's surface, the komatsuna has relatively high germination rate

of 97.2 % but the komatsuna seedlings did not firmly and deeply strike their roots into the urethane mat. Most komatsuna seedling's roots were elongated but stayed outside the urethane block moistened with water, thus komatsuna seedlings were supplied with insufficient quantity of water and seedlings were tent to be bent down at the 3rd day of reaching their cotyledon stage. The 7th day germinations of the komatsuna at different planting depth of mat's surface, half seed's thickness, 0, 1, 2, 3, 4 and 5 mm are shown from left to right and up to down in Fig. 7.

This situation did not occur with those seedlings seeded at the planting depth of from more than half of seed's thickness to 5 mm and the seedlings were fairly grown but the at the planting depth of 5 mm the germination rate of 83.3 % was not so high in comparison with at plant-

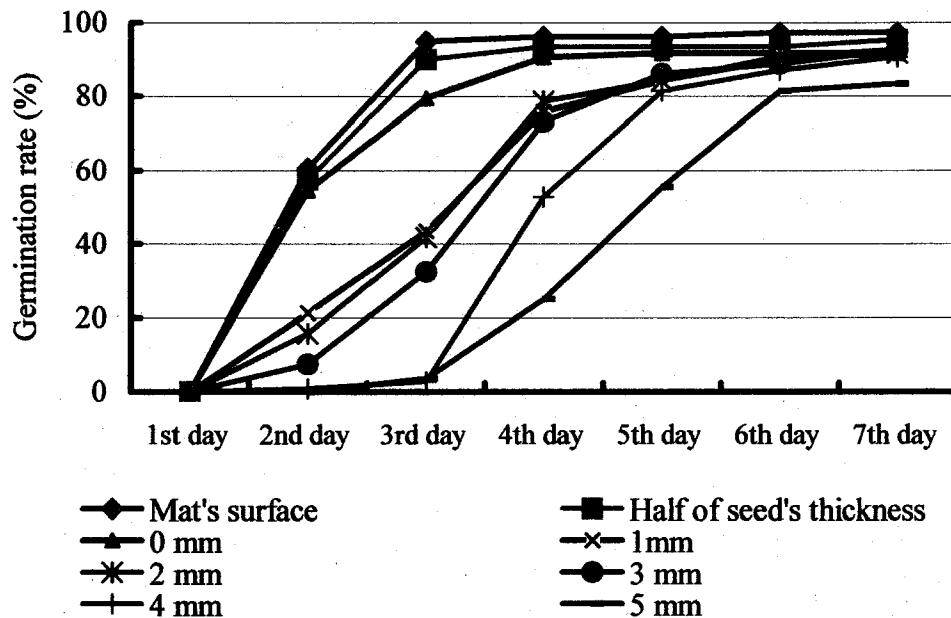


Fig. 6. Komatsuna germination rate at different planting depth

Table 1. Komatsuna seed's sizes

Tested Seed	Length (mm)		Width (mm)		Thichness (mm)		Weight of 1000 grains (g)
	Averesge	S.D.	Averesge	S.D.	Averesge	S.D.	
Komatsuna	1.90	0.12	1.72	0.10	1.57	0.13	3.24

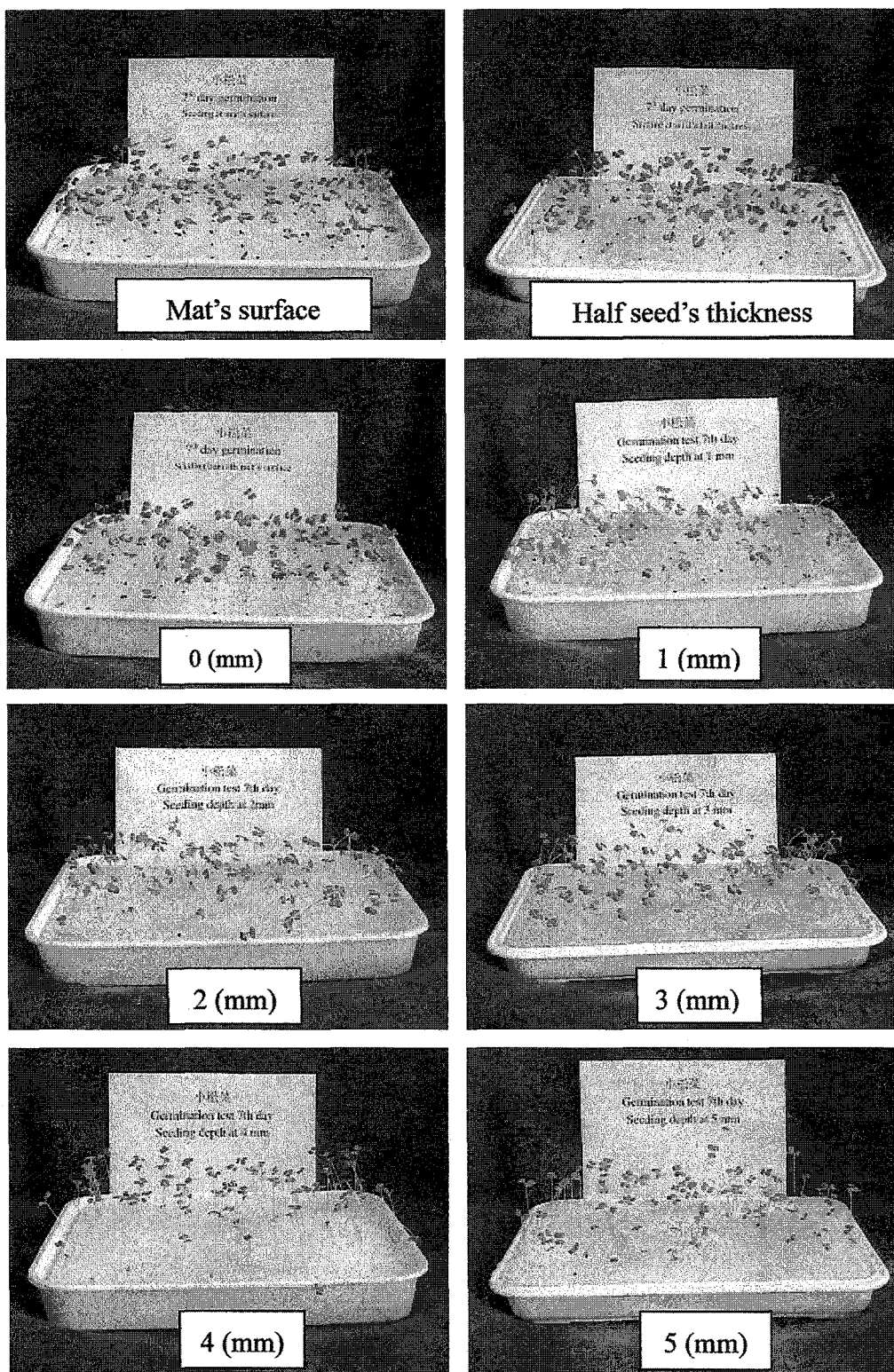


Fig. 7. Germination of komatsuna at different planting depth on the 7th day after planting

ing depths of half of seed's thickness 0, 1, 2, 3 and 4 mm.

From above mentioned facts we found that the planting depths of from more than half of seed's thickness to 4 mm did provide good germination and growth of komatsuna seedlings in the urethane mat.

IV CONCLUSION

The komatsuna seeds were seeded at different planting depths to investigate the effect of planting depth on its germination. From the experiment results we could point out that the planting depths of from more than half of seed's

thickness to 4 mm would provide the komatsuna seedlings the best germination condition and healthy growth in the hydroponics urethane mat. This finding planting depth can be use as a design parameter for the punching depth of the seed punching mechanism.

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ウレタンマット用養液栽培における小松菜の発芽に関する研究

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要 約

本研究は、ウレタンマットを用いた養液栽培において、コマツナ（サラダ野菜）の播種深さが出芽に及ぼす影響を検討したものである。実験は播種深さを、マット表面、種子半分の深さおよび深さ0, 1, 2, 3, 4, 5 mmの8要因について3回繰り返し替えた。実験の結果、出芽率は播種深さが増加すると減少する傾向となり、マット表面で97.2%、種子半分の深さで95.4%、0 mmで91.6%、1 mm深で92.6%、2 mm深で91.7%、3 mm深で92.6%、4 mm深で90.7%、5 mm深で83.3%となった。コマツナの播種深さは、マット上や出来るだけ浅い方が出芽率は良好であったが、ウレタンマットへの根の進入や苗生育を考慮すると、機械播種の面からは、種子半分以上の深さから4 mm深までが実用的であることが判った。本研究で得られた播種深さは、ウレタンマットを用いた養液栽培の播種機構の設計資料となるものである。

キーワード：水耕栽培、発芽、小松菜、ウレタンマット、播種機構

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