J. Trop. Agric. and Fd. Sc. 26(2) (1998): 111–117

Potential of bunching onion (*Allium fistulosum* L.) cultivars on oligotrophic peat

[Potensi tanaman 'bunching onion' (*Allium fistulosum* L.) di tanah gambut]

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Key words: bunching onion, fertilizer, planting density, yield

Abstrak

Dua kajian untuk menilai kultivar 'bunching onion' telah dijalankan di tanah gambut. Dalam kajian yang pertama, kultivar-kultivar ini ditanam dan dibaja dengan dua kadar N dan K. Tiada perbezaan hasil didapati antara kultivar ini. Yang berbeza hanya kultivar Ishikura dan Feast mempunyai satu batang semu. Kultivar Fragrant dan Feast mempunyai berbilang batang semu (> 4) dan lebih sesuai sebagai daun bawang. Kultivar 'bunching onion' yang mempunyai satu batang semu adalah lebih tinggi pokoknya dan lebih besar batang semunya dibandingkan dengan jenis kultivar yang mempunyai berbilang batang semu. Kadar baja N dan K yang tinggi memberi hasil dan pokok yang lebih tinggi. Kadar N dan K tiada kesan pada saiz batang semu. Dalam kajian yang kedua, keempat-empat kultivar ini ditanam pada dua jarak tanaman. Pokok kultivar Ishikura lebih tinggi daripada kultivar Feast. Begitu juga hasilnya dibanding dengan hasil kultivar Feast. Tiada perbezaan saiz batang semu didapati antara dua kultivar ini pada dua jarak tanaman. Kedua-dua kajian ini menunjukkan bahawa 'bunching onion' boleh ditanam di tanah rendah tropika asalkan kultivar dan amalan agronomi yang sesuai digunakan.

Abstract

Four imported bunching onion cultivars were evaluated on Malaysia's oligotrophic peat in two experiments. In the first experiment, the cultivars were planted and given two rates of N and K. No yield differences were detected among the cultivars. Only cultivars Ishikura and Feast had single long blanched pseudostems. The other two cultivars, Fragrant and Linda, had many tillers (> 4 tillers) and were more suitable for use as spring onion. The two bunching onion cultivars identified were also taller and had bigger pseudostems than the tillering cultivars. Higher N and K levels resulted in higher yields and taller plants. The N and K levels had no effect on the size of the pseudostem. In the second experiment, the four cultivars were planted at two planting densities. The cultivar Ishikura was taller and had significantly higher yield than the other bunching onion cultivar, Feast. No differences were detected in the pseudostem size of cultivars at the two planting densities. The experiments indicated that bunching onion can be successfully grown in the lowlands of the tropics provided the right cultivar is used, together with suitable agronomic practices.

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Introduction

Bunching onion is a totally imported vegetable, commonly used for culinary purposes and is a popular vegetable among Asian expatriates and recently with locals in Malaysia. As stated in Malaysia's National Agricultural Policy (1992–2010), the government encourages and promotes the cultivation of vegetables for import substitution (Anon. 1993). In 1996, Malaysia imported 360 894 tons of onion, shallot, garlic and other alliaceous vegetables (fresh or chilled) worth a total of RM275 million (Anon. 1997) which is equivalent to about 42% of Malaysia's total fresh vegetable import. There is definitely a need to reduce this great loss in foreign exchange. The substantial import figure is due solely to the lack of local commercial production of allium. Except for shallot and some onion cultivars, the other alliums can only be grown in the highlands (800–2 000 m above sea level) of Malaysia. However, the cultivation of other temperate vegetables like bell pepper, Chinese cabbage and tomato, is economically more appealing than that of allium. Furthermore, land is limited in the highlands and this leaves only the lowlands for possible future production. Even in the lowlands, suitable land for vegetable cultivation is limited due to rapid industrialization and competition with perennial crops. This has resulted in vegetables being planted on problem soils like peat. However, Malaysia's oligotrophic peat soil needs to be physically and chemically ameliorated before it can be used for cultivation of crops.

The high cost of allium bulbs used as planting materials is the major factor in the high production cost of allium. Therefore, planting of heat-resistant allium using seeds is the best alternative in allium production in the lowlands of hot humid tropical Malaysia. The average diurnal temperature for the highlands and lowlands of Malaysia are 13–20 °C and 23–33 °C respectively (Nieuwolt 1982).

With this in mind, two studies were conducted under netted structure on peat, using imported seeds of heat-resistant cultivars of bunching onion at different fertilizer levels and planting densities.

Materials and methods

Two experiments were conducted on drained oligotrophic peat under netted structure in Klang, Selangor, Malaysia. Seeds were sown in seedling trays in August 1996 and seedlings were transplanted in October 1996, approximately 50 days after seeding. The seedlings ready for transplanting have pseudostems about 0.3–0.4 cm thick and 12–15 cm tall. Soil analysis on peat was carried out before planting. The average N, soluble P and exchangeable K cation for peat were 1.25%, 36 ppm and 0.63 meq/100 g respectively.

Four heat-resistant cultivars of bunching onion were used. The Japanese cultivars were Ishikura and Feast, while the Taiwanese cultivars were Fragrant and Linda.

In the first experiment, the four cultivars were evaluated at two fertilizer levels. A 4 x 2 factorial experiment was laid out in a randomized complete block (RCB) design with four replications. The fertilizers applied in kilograms per hectare were:

- 100 N: 100 P: 100 K and
- 166 N: 100 P: 166 K.

The fertilizers used were ammonium sulphate, triple superphosphate (TSP) and muriate of potash to supply N, P and K respectively. NPK Blue Special (12:12:17) was used only in the side dressing. The time of application was basal and at 1.5 months after transplanting. TSP was used in the basal application only. The fertilizers were mixed into the soil in the basal application a day before transplanting. In the side dressing, the fertilizers were applied along the crop rows and irrigated immediately to avoid scorching of the leaves. The beds measured 0.9 m x 2 m with 0.8 m interbed furrows. The planting distance used was 20 cm x 15 cm (between x within). Daily irrigation was carried out whenever necessary using microjet sprinklers. The frequency of irrigation varied according to the weather.

In the second experiment, the same four cultivars were used at two planting densities. A 4 x 2 factorial experiment laid out in RCB design with three replications was used. The planting distances evaluated were:

- 15 cm x 15 cm and
- 15 cm x 10 cm.

The level of fertilizer used in kilograms per hectare was 166 N, 100 P and 166 K. The method and time of application were similiar to those used in the first experiment. The beds measured 0.9 m x 1.5 m with 0.8 m interbed furrows.

The pH of cultivated peat soil was about 5.0, and it was raised to 5.5 using ground magnesium limestone at 2.5 t/ha for every 0.15 pH unit increase (Chew et al. 1986). Liming was carried out 2 weeks before transplanting. Common trace elements were applied as a basal dressing together with the major nutrients, in accordance with Leong et al. (1985). Weeding was carried out manually whenever necessary.

Yield of the bunching onion, plant characteristics and disease infection were recorded. The weight of the whole plant was taken as the yield of the crop. The bunching onion was harvested at 3 months after transplanting. Composite samples of pseudostem and leaves from randomly selected plants were analysed for N and K.

Results and discussion

Yield

In the first experiment, no yield differences were detected among the four cultivars evaluated *(Table 1).* However, only the cultivars from Japan, namely Ishikura and Feast, have a single blanched pseudostem. The cultivars Fragrant and Linda from Taiwan have multitillers with shorter pseudostems. The multitillers could have compensated for no yield difference compared with the bulky single-pseudostem cultivars. This showed that both types of bunching onion cultivars can be cultivated on peat in the lowlands of tropical Malaysia. This further illustrated that bunching onion can be raised from seed. The result is in contrast to the report by Oyen and Soenoeadji (1993) that it was difficult to raise bunching onion seedlings from seeds under tropical conditions.

Significant yield differences were found between the two fertilizer levels. The treatment with 166 N, 100 P and 166 K kg/ha recorded a higher yield *(Table 1).* This indicated that the lower fertilizer level is insufficient for the production of bunching onion in the lowlands. However, the current higher fertilizer level may not be the maximum level. Therefore, there is a need to investigate further the effects of higher fertilizer levels on bunching onion in the lowlands.

No interaction effect was noted between the two factors.

In the second experiment, significant yield differences were detected among the different bunching onion cultivars *(Table 2).* Single-pseudostem Ishikura was superior to Feastal, although no significant differences

Table 1. Effect of cultivar and fertilizer level on bunching onion yield

Treatment	Yield (kg/plot)	Extrapolated yield (t/ha)
Cultivar		
Ishikura	12.56	36.94
Feast	11.06	32.52
Fragrant	11.90	34.99
Linda	12.38	36.40
LSD (5%)	2.13	6.26
Fertilizer level		
100 N, 100 K (kg/ha)	11.06	32.53
166 N, 166 K (kg/ha)	12.89	37.91
LSD (5%)	1.67	4.90
Mean	11.98	35.23
SE	2.045	6.014
C.V.(%)	17.1	17.1

were detected between Ishikura and the multitiller cultivars. The variation in the performance of the cultivars was probably influenced by the planting distance.

Planting at a closer distance of 15 cm x 10 cm produced significantly higher yield than that at 15 cm x 15 cm *(Table 2)*. This is because it (294 000 plants/ha) has about 50% more plants than treatment at 15 cm x 15 cm (196 000 plants/ha). This indicated that planting density can greatly influence the yield of bunching onion. In contrast, the currently recommended planting distance of 30–40 cm x 20–30 cm for bunching onion in Indonesia can only give an average yield of 6.8 t/ha (Permadi 1994). This suggested that closer planting should be recommended for bunching onion in the tropical lowlands.

Table 2. Effect of cultivar and planting distance on bunching onion yield

Treatment	Yield (kg/plot)	Extrapolated yield (t/ha)
Cultivar		
Ishikura	12.83	50.29
Feast	10.75	42.14
Fragrant	12.13	47.54
Linda	11.62	45.55
LSD (5%)	1.61	6.30
Planting distance		
15 x 10 (cm)	12.67	49.67
15 x 15 (cm)	10.99	43.08
LSD (5%)	1.14	4.46
Mean	11.83	46.39
SE	1.299	5.092
C.V. (%)	10.9	10.9

No interaction effect was noted between the two factors. No disease was noted in both experiments. Some common leaf eaters, e.g. *Spodoptera* sp., were easily controlled by spraying of pesticides. The low incidence of pests and diseases is probably due to bunching onion being a new crop. Furthermore, the netted structure did prevent/reduce the entry of most lepidopterous pests.

Plant height

Plant height was measured from the stem-root junction to the tip of the longest leaf when all the leaves were clumped together. From *Table 3*, Ishikura was significantly taller than the rest of the cultivars in the first experiment. No difference was detected between Feast and Linda. Higher fertilizer level also resulted in taller plants *(Table 3)*. Plant height is probably an inherent characteristic of individual cultivars. Ishikura and Feast cultivars had only one pseudostem (tiller), whereas Fragrant and

Table 3. Effect of cultivar and fertilizer level on bunching onion plant height and pseudostem size

Treatment	Plant height (cm)	Pseudostem size (cm)	
		Length	Girth
Cultivar			
Ishikura	94.58	25.09	1.99
Feast	87.42	23.60	2.08
Fragrant	75.89	15.23	0.91
Linda	89.45	16.46	1.34
LSD (5%)	3.36	1.29	0.17
Fertilizer level			
100 N, 100 K (kg/ha)	85.55	19.99	1.58
166 N, 166 K (kg/ha)	88.12	20.21	1.58
LSD (5%)	2.37	0.91	0.12
Mean	86.84	20.10	1.58
SE	3.229	1.238	0.160
C.V. (%)	3.7	6.2	10.1

Linda cultivars had an average of 4–5 pseudostems (multitillers). Higher fertilizer levels can probably induce the plants to grow taller which may indirectly influence the yield obtained.

In the second experiment, Ishikura was again significantly taller than the rest of the cultivars. However, no significant differences were detected among the other cultivars. Similarly, no differences were detected between the two planting distances *(Table 4).*

This showed that plant height was not affected by closer planting. Plant height was more related to individual cultivar characteristics. Generally, the single-pseudostem cultivars had taller plants than the multitiller cultivars.

Length of pseudostem

This parameter was measured from the pseudostem-root junction to the youngest leaf-pseudostem junction. The single-pseudostem cultivars, Ishikura and Feast, had significantly longer pseudostems than those of the multitiller cultivars *(Table 3)*. No significant difference was detected between the crops given different fertilizer levels. The higher fertilizer level had no effect on the length of the pseudostem. Generally, the single-pseudostem cultivars had longer white pseudostems than the multitiller cultivars.

In the second experiment, the single-pseudostem cultivars of Ishikura and Feast recorded significantly longer pseudostem than the multitiller cultivars *(Table 4)*. No differences were detected between Ishikura and Feast. Similarly, no significant differences were detected between the two planting densities. This shows that planting distance has minimal effect on the length of the pseudostem. The length of the pseudostem is more dependent on the inherent characteristics of individual cultivars.

Stem girth of pseudostem

The girth (diameter) was measured at mid-way up the pseudostem. Ishikura and Feast recorded significantly bigger girths than the multitiller cultivars of Linda and Fragrant *(Table 3)* in the first experiment. Different fertilizer levels had no effect on the girth of the pseudostem. This shows that stem girth is closely related to individual cultivar and higher fertilizer level does not influence its size.

Table 4. Effect of cultivar and planting distance on bunching onion plant height and pseudostem size

Treatment	Plant height (cm)	Pseudostem size (cm)	
		Length	Girth
Cultivars			
Ishikura	93.25	24.81	1.85
Feast	86.93	24.28	1.87
Fragrant	72.91	15.75	1.00
Linda	81.93	15.75	1.05
LSD (5%)	5.73	1.74	0.19
Planting distance			
15 x 10 (cm)	84.32	20.19	1.49
15 x 15 (cm)	83.19	20.11	1.39
LSD (5%)	4.05	1.23	0.13
Mean	83.76	20.15	1.44
SE	4.627	1.404	0.151
C.V. (%)	5.5	6.9	10.5

In the second experiment, Ishikura and Feast again recorded significantly bigger girths than the pseudostems of multitiller cultivars *(Table 4)*. No significant difference was detected between Ishikura and Feast. Similarly, no significant difference was noted between the two planting distances. The closer planting did not affect the size of the pseudostem, thus maintaining its quality comparable with the wider planting distance. This resulted in higher yield with no sacrifice in quality of the pseudostem.

Nutrient content

The analysis was carried out only for the first experiment. The N and K contents in Feast were significantly higher than those in Linda the multitiller cultivar, though no difference was detected between the rest of the cultivars *(Table 5)*. The differences in the nutrient contents in the various cultivars were, however, not reflected in the yield obtained. Higher applied fertilizer level recorded significantly higher N and K contents. The higher nutrient content was reflected in the yield obtained, reconfirming the need for higher fertilizer level in bunching onion.

Table 5. Effect of cultivar and fertilizer level on the N and K content of bunching onion

Treatment	N content (%)	K content (%)
Cultivar		
Ishikura	1.77	2.45
Feast	1.81	2.51
Fragrant	1.58	2.37
Linda	1.51	2.32
LSD (5%)	0.28	0.07
Fertilizer level		
100 N, 100 K (kg/ha)	1.52	2.17
166 N, 166 K (kg/ha)	1.82	2.66
LSD (5%)	0.20	0.28
Mean	1.67	2.42
SE	0.224	0.318
C.V. (%)	13.4	13.2

Conclusion

Bunching onions from temperate and sub-tropical countries can be successfully grown from seeds on peat in the lowlands of tropical Malaysia. Ishikura is the best among the single-pseudostem cultivars *(Plate 1)*.

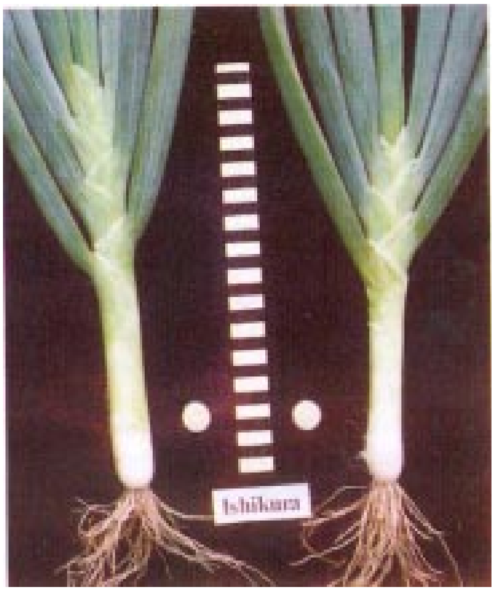

Plate 1. Single-pseudostem bunching onion cv. Ishikura

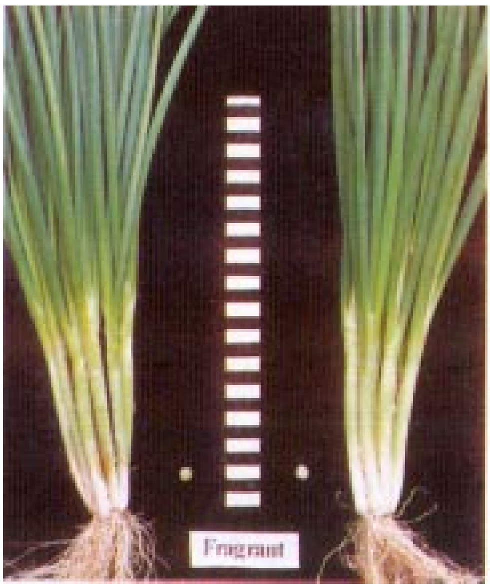

Plate 2. Multitiller-pseudostem bunching onion cv. Fragrant (more suitable as spring onion)

Linda and Fragrant the multitiller-pseudostem cultivars *(Plate 2)* are equally good. As higher fertilizer rate is essential for bunching onions on peat, there is a need to investigate further the fertilizer requirement. Planting at 15 cm x 10 cm has resulted in higher yield with no sacrifice in pseudostem quality. Therefore, there is great potential for bunching onions to be introduced as a new crop in Malaysia.

Acknowledgements

The authors would like to thank Dr Izham Ahmad for his comments, Ms Fathmah Mokhtar and Mr Amat Jupri for technical assistance, and Ms Anita Abbas for typing the manuscript.

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Accepted for publication on 17 April 1998