Effect of Controlled-release Fertilizers on Nitrate Content and Yield of Japanese Mustard Spinach.

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Introduction

CRFs

Controlled-released fertilizers (CRFs) are classified into 3 different types; slow-released fertilizers, coated fertilizers, and fertilizers containing nitrification inhibitors. CRFs have been reported to show higher fertilizer effects than soluble fertilizers such as urea and ammonium sulfate.

Nitrate in vegetables

Vegetables such as spinach and mustard spinach can contain high nitrate content among other vegetables. Consumption of vegetables with high nitrate content may cause methemoglobinemia. Therefore, it is necessary to reduce the nitrate content of these vegetables.

Reducing nitrate content

It's been reported that CRF application can reduce N fertilizer application rates while increasing crop yields. Also, CRF application for vegetable production can reduce nitrate content in some vegetables.

Objectives

Effects of application of different CRFs on nitrate content and yield of Japanese mustard spinach (*Brassica rapa*) were evaluated through 2 pot experiments.

Materials and Methods

Soil

- Typic Dystrochrept (0-15 cm; Tokyo, Japan)
- Oven dried (45°C) with 2 mm sieved for experiment

Table 1. Soil chemical characteristics

pH	EC ($\mu S\ cm^{-1}$)	Total C ($g\ kg^{-1}$)	Total N ($g\ kg^{-1}$)	C/N	NO_3^--N ($mg\ kg^{-1}$)	NH_4^+-N ($mg\ kg^{-1}$)
7.17	51.9	39.9	2.83	14.1	0.056	12.0

Crop

- Japanese mustard spinach (*Brassica rapa*)

Fig. 1 Japanese Mustard Spinach (*Brassica rapa*)

Fertilizers

- Nitrogen:
  - Urea (46.6% N) as quickly available fertilizer (UR)
  - CDU (30% N) as slow-released fertilizer (SF)
  - Coated urea (42% N) as resin-coated fertilizer (CF)
  - Urea containing nitrificaiton inhibitors (0.4% AM*; 46.6% N) as fertilizer containing nitrification inhibitor (NI)

  (* 2-amino-4-choro-6-methylepyrimidine)
- Phosphate: Superphosphate (17.5% P_2O_5)
- Potassium: Potassium chloride (52.4% K_2O)

Pot experiments

① The same amount of N was applied based on recommended N rate (140 kg ha^{-1}) for the spinach from different fertilizers.

- Five treatments included no fertilizers added (CR), urea (UR), slow-released fertilizer (SF), resin-coated fertilizer (CF), and fertilizer containing nitrification inhibitor (NI).

② The recommend and reduced rates of N was applied from different fertilizers.

- Ten treatments included the recommended rate (CR, SF, CF, and NI), 10%-reduced rate for SF, CF, and NI (SF10, CF10, and NI10), and 20%-reduced rate for SF, CF, and NI (SF20, CF20, and NI20).

Analyses

- Plant dry weight
- Plant nitrate content
- Plant nitrate accumulation (dry weight x nitrate content)

Results and Discussion

① First pot experiment

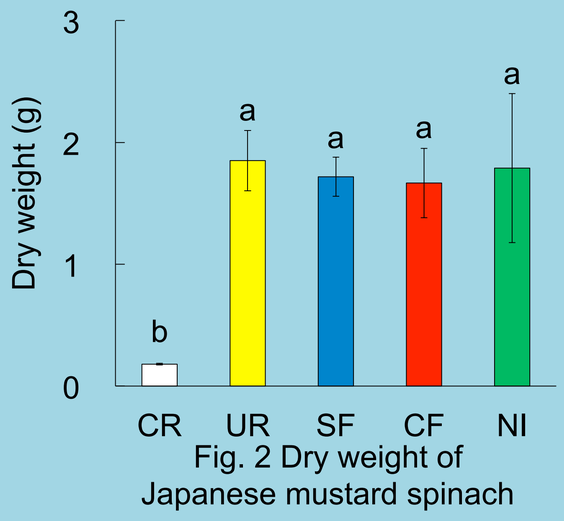

Fig. 2 Dry weight of Japanese mustard spinach

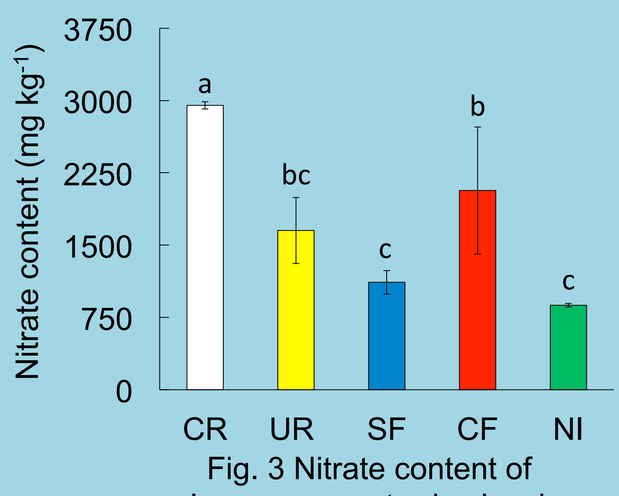

Fig. 3 Nitrate content of Japanese mustard spinach

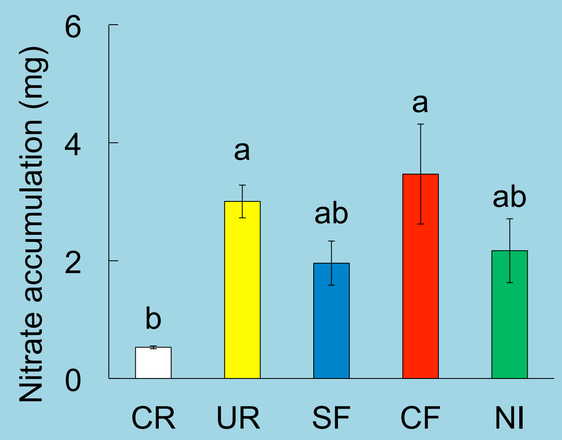

Fig. 4 Nitrate accumulation of Japanese mustard spinach

Fig. 5 First pot experiment

- There were no significant differences in the dry weights among all treatments (Fig.2).
- SF and NI treatments had lower nitrate content than other treatments (Fig. 3).
- SF and NI treatments had lower nitrate accumulation than other treatments (Fig.4).
- The CRFs used in this study may have equivalent fertilizer effects compared with readily soluble fertilizer.

②Second pot experiment

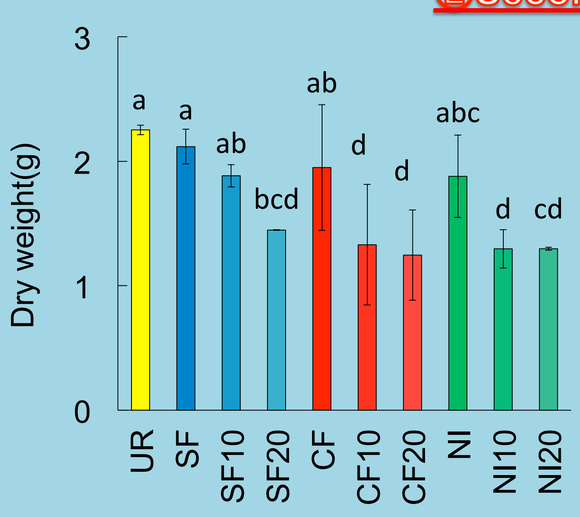

Fig. 6 Dry weight of Japanese mustard spinach

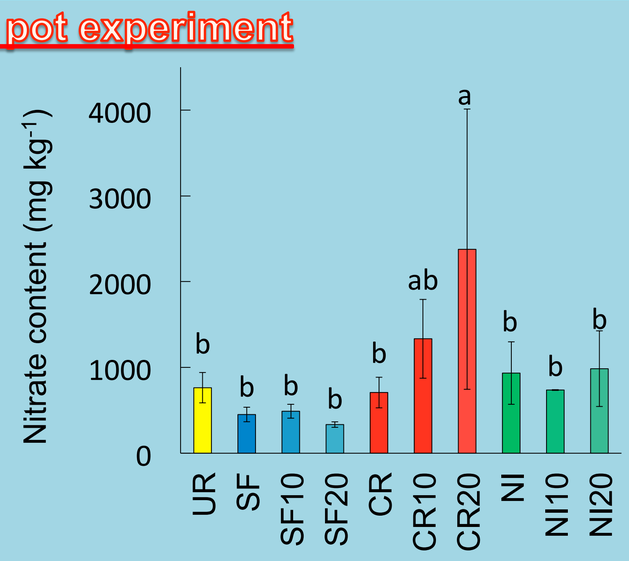

Fig. 7 Nitrate content of Japanese mustard spinach

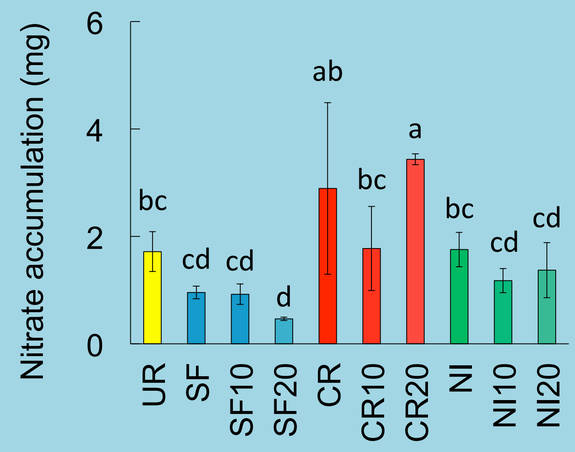

Fig. 8 Nitrate accumulation of Japanese mustard spinach

Fig. 9 Second pot experiment

- The dry weights in SF and SF10 were comparable (Fig. 6).
- SF, SF10, and SF20 had lower nitrate content than other treatments (Fig. 7).
- SF, SF10, and SF20 showed significantly lower nitrate accumulation than did UR (Fig. 8).
- It appeared that SF reacted differently from CF and NI in the soil because it was urea condensation Product.

Conclusions

- The CRFs may have equivalent fertilizer effects compared with readily soluble fertilizer for Japanese spinach grown in pots.
- It was found that SF could cause low nitrate accumulation in spinach due to slow release capability, hence gradual plant absorption, without negatively affecting the crop yield.