

# Effect of Methanol on the Growth of Field Crops Under Water Stress on Bangkok Plain

Wattanaporn Meskuntavon<sup>(1)</sup> Tin Muang Aye<sup>(1)</sup> N.S. Murali<sup>(2)</sup>

## ABSTRACT

Studies conducted in Arizona, USA, have shown that methanol can enhance the growth of field crops under hot and dry climatic conditions. To investigate the effectiveness of methanol on Bangkok Plain, field experiments with rice, soybean, cotton and tomato were conducted at the Asian Institute of Technology, Pathum Thani province, during the 1994 dry season (January to May). Treatments consisted of spraying 10% methanol (v/v) at three rates: 1090, 2180 or 4360 l ha<sup>-1</sup>. Depending on the plant species, 3 to 5 sprays were made during the experimental period, using a power sprayer between 1200 and 1400 hours. The results showed no significant effect of methanol on the growth of all four plant species. The lack of response to methanol could be due to the differences in concentration of methanol used or the climatic conditions.

**Keywords:** field experiment, water use, rice, soybean, cotton, tomato.

## INTRODUCTION

Foliar application of methanol has been suggested as a means of increasing the water use efficiency of plants through enhanced growth. Field studies conducted on irrigated farm in the deserts of Arizona, USA, have shown that methanol can increase the growth of cotton, wheat, melons and roses (Nonomura and Benson 1992). Furthermore, spraying methanol can double the growth rate while requiring only half as much water as untreated plants. If methanol can increase the water use efficiency of crops, there would be a large potential for increasing yields in the arid and semi-arid regions of the tropics.

The objective of the preliminary study was to investigate the influence of methanol on the growth and performance of field crops such as rice, soybean, cotton and tomato subjected to water stress on Bangkok Plain.

## MATERIALS AND METHODS

Research was conducted at the Agricultural System Research Farm of Asian Institute of Technology, Pathum Thani province, during the dry

season from January to May 1994. During the experimental period, the total rainfall was 133 mm in 15 rainy days, the day temperature varied from 29.9°C to 36.7°C, the night temperature varied from 17.0°C to 25.2°C, and the relative humidity varied between 67 and 71%. The soil is classified as Sulfic Tropaquepts (Acid Sulphate) soil, which is heavy clay with 65% clay and has a pH range from 4.0 to 5.0 in 0-300 mm depth.

Methanol treatment consisted of three levels of 10% methanol (v/v) application: 1090, 1180 or 2360 l ha<sup>-1</sup> with each application. Treatments were applied using full stream pressure of a power sprayer during the afternoon between 1200 to 1400 hours. The total experimental area of each crop was 100 m<sup>2</sup>.

Rice experiment was laid out as a latin square design with three replicates. However, experiments with soybean, cotton and tomato were laid out as a randomised complete block design with three replicates and the treatments consisted of a control and the above three methanol applications. Control was sprayed with water.

Rice (*Oryza sativa* L. cv. Suphan Buri 90) seeds were sown on 13th January 1994 at a row

(1) Asian Institute of Technology, G.P.O. Box 2754, Bangkok 10501

(2) Danish Institute of Plant and Soil Science, Lottenborgvej 2, 2800 Lyngby, Denmark

spacing of 30 cm and at a seed rate of 50 kg ha<sup>-1</sup>. Compound fertilizer (16-20-0) was applied the rate of 150 kg ha<sup>-1</sup> and 100 kg ha<sup>-1</sup> on 18 days and 33 days after sowing (DAS), respectively. Spraying of methanol was done on 40, 48, 51, 57 and 64 DAS in all treatments. Irrigation was given twice a week until 36 DAS and was repeated on 45 and 53 DAS. Plants were harvested 67 DAS.

Soybean (*Glycine max* (L.) Merr. cv. SJ5) was cultivated on raised beds in rows, with two plant rows in each bed and the row spacing was 50 cm. The seeds were inoculated with 150 g rhizobium per kg of seeds and were sown on 13th January 1994. Eighteen DAS, Ca(OH)<sub>2</sub> was applied the rate of 1.25 t ha<sup>-1</sup> and the seeds were replanted due to uneven germination. Two weeks after replanting, thinning was done to have a plant spacing of 20 cm. Methanol treatments were given on 22, 30, 33, 40 and 46 DAS. Watering was done twice a week until 18 DAS and was repeated on 27 and 35 DAS. Monocrotophos at 1 ml l<sup>-1</sup> was applied on 17 and 47 DAS, and Monocrotophos at 0.75 ml l<sup>-1</sup> with Orthocide at 1 g l<sup>-1</sup> was applied on 38 DAS. Plants were harvested 80 DAS.

Tomato (*Lycopersicon esculentum* Mill. cv. Srida Hangchat) seeds were sown in a tray on 20th January 1994 for production of seedling. Twelve days old seedlings were planted in plastic bags for transplanting in the field. During the land preparation, Ca(OH)<sub>2</sub> was applied at the rate of 1.25 t ha<sup>-1</sup>. After land preparation, 30 days old plants were transplanted to the field beds of 1 m width. Plant spacing was 50 cm between rows and 75 cm within rows. Compost at 3 t ha<sup>-1</sup> was applied at the time of transplanting. Methanol was sprayed on 35, 46 and 63 days after transplanting. Watering was done twice weekly until four weeks after transplanting. Monocrotophos at 1 ml l<sup>-1</sup>, Orthocide at 1 g l<sup>-1</sup> and compound fertilizer (11-45-11) at 1 g l<sup>-1</sup> were sprayed on 7 and 25 days after transplanting. The plants were harvested 82 days after transplanting.

Cotton (*Gossypium hirsutum* L. cv. Srisumrong 60) seeds were sown on 4th February 1994 at a spacing of 1 m between rows and 0.5 m between plants at a seed rate of 30 kg ha<sup>-1</sup>. At the time of sowing, compound fertilizer (16-20-0, 50 kg ha<sup>-1</sup>), compost (3 t ha<sup>-1</sup>) and Ca(OH)<sub>2</sub> (1.25 t ha<sup>-1</sup>) were applied. Methanol was sprayed on 33, 42 and 62

DAS. Plots were irrigated until four weeks after sowing. Two and three weeks after sowing, Monocrotophos at 1 ml l<sup>-1</sup> was sprayed. 43 DAS, Monocrotophos at 1 ml l<sup>-1</sup>, Orthocide at 1.5 g l<sup>-1</sup>, compound fertilizer (11-45-11) at 1.5 ml l<sup>-1</sup> and surfactant at 1.5 ml l<sup>-1</sup> was applied. The plants were harvested 90 DAS.

## RESULTS AND DISCUSSION

Dry matter production of rice at harvest did not show any significant differences among the methanol treatments (Table 1).

Total plant dry matter and pod yields of soybean at harvest are shown in Table 2. Neither of the yields were significantly effected by any of the methanol treatments. There was also no differences between control and methanol treatments.

Tomato fruit and dry matter yields are presented in Table 3. The number of fruits and yields were not significantly different among methanol treatments and in relation to control.

Cotton boll and plant dry matter yields of cotton at harvest are presented in Table 4. None of the parameters showed any significant differences among the methanol treatments and in relation to control.

In all four plants species, there were no differences in plant growth or recovery from water stress with methanol treatment. However, Nonomura and Benson (1992) in Southwest Arizona, USA,

**Table 1. Total dry matter yield of rice at harvest.  $\pm$ indicate 1 SE.**

Treatments (l 10% methanol (v/v) ha <sup>-1</sup> )	Dry matter (g m <sup>-2</sup> )
1090	878.8 $\pm$ 93
2180	818.2 $\pm$ 198
4360	828.3 $\pm$ 165

**Table 2. Soybean dry matter and pod yields at harvest.  $\pm$ indicates 1 SE.**

Treatments (l 10% methanol ha <sup>-1</sup> )	Dry matter (g m <sup>-2</sup> )	Pod yield (g m <sup>-2</sup> )
0	36.4 $\pm$ 0	68.6 $\pm$ 0
1090	35.4 $\pm$ 2	57.1 $\pm$ 6
2180	41.6 $\pm$ 6	69.5 $\pm$ 15
4360	39.7 $\pm$ 5	68.3 $\pm$ 12

**Table 3. Number of fresh fruits, weight of fresh fruits and plant dry matter weight of tomato at harvest.  $\pm$ indicate 1 SE.**

Treatments (l 10% methanol ha <sup>-1</sup> )	Fresh fruit per m <sup>2</sup>		Plant dry matter (g m <sup>-2</sup> )
	number	weight (g)	
0	13.6 $\pm$ 0	56.0 $\pm$ 0	63.0 $\pm$ 0
1090	17.9 $\pm$ 2	83.8 $\pm$ 5	89.4 $\pm$ 2
2180	19.1 $\pm$ 5	95.5 $\pm$ 19	88.9 $\pm$ 14
4360	15.9 $\pm$ 1	78.2 $\pm$ 5	91.4 $\pm$ 5

**Table 4. Number of mature boll, weight of mature boll and plant dry matter yield of cotton at harvest.  $\pm$ indicate 1 SE.**

Treatments (l 10% methanol ha <sup>-1</sup> )	Mature boll per m <sup>2</sup>		Plant dry matter weight (g m <sup>-2</sup> )
	number	weight (g)	
0	2.8 $\pm$ 0.0	22.0 $\pm$ 0	80.0 $\pm$ 0
1090	3.9 $\pm$ 0.9	30.8 $\pm$ 7	62.6 $\pm$ 9
2180	4.2 $\pm$ 0.4	32.3 $\pm$ 3	79.3 $\pm$ 26
4360	3.9 $\pm$ 0.4	30.3 $\pm$ 4	66.7 $\pm$ 15

obtained bigger size cabbages with 20% methanol application compared to untreated cabbages. In cotton, a single foliar treatment with 30% methanol yielded enlarged leaves and taller cotton plants than control after two weeks. Methanol treated tomato leaves and stems were 25-50% thicker in diameter over untreated. The lack of growth response to methanol in the present study could be due to the differences in the methanol concentration used and the climate. Since it was slightly windy at times of application, single application of 10% methanol (1090 l ha<sup>-1</sup>) did not retain the solvent on the plants for more than a minute due to evaporation. Thus higher application rates were used to increase the retention

of methanol on the plants and to enhance methanol uptake. However, extended applications did not have any influence on the growth and thus a higher concentration would probably be required. Furthermore, factors such as time and method of application could also have an influence on the plant growth. Further studies should be conducted taking into account these factors.

#### ACKNOWLEDGEMENTS

We would like to thank the staff of AFE Program especially Mr. Phairat, Mr. Boontom and Mr. Prasit for all the assistance in the field. Financial support by Danida is highly appreciated.

#### REFERENCE

- A. M. Nonomura and A. A. Benson, 1992. The path of carbon in photosynthesis: Improved crop yields with methanol. Proc. Natl. Acad. Sci. USA. Vol.89, pp. 9794-9798.