USING AMS-1 SUPER WATER-ABSORBENT TO IMPROVE DROUGHT-TOLERANT CAPACITY OF UPLAND CROPS IN THE CENTRAL HIGHLANDS AND SOUTH EASTERN REGION OF VIETNAM

The Central Highlands and Eastern Region of southern Vietnam have a monsoon climate with a rainy season from May to October and dry season from November to April. In order to increase efficiency of agricultural production in the dry season, management practices resulting in greater water retention by the soil are considered the most effective management strategy. Beside of the traditional ways of improving soil water retention such as surface mulching, organic matter application and drought-tolerant species screening, application of highly water-absorbent material has been recommended as an effective mean to improve soil water-retention capacity thus increasing crop yield during drought period. AMS-1 is a super water-holding material produced by the Chemistry Institute of The National Center of Science and Technology through a process of synthesizing acrylic acid with treated starch. This material has a high molecular weight and is biodegradable. It has a high water retention capacity. AMS-1 use has been recognized as an advanced technology by the Ministry of Science and Technology and recommended by the Ministry of Agriculture and Rural Development (MARD) for upland crop production. The main purpose of this study is to investigate the effectiveness of AMS-1 super water-absorbent in improving drought tolerance of major upland crops in the Central Highlands and Eastern Region of southern Vietnam.

Water retention capacity of AMS-1

The maximum amount of water retained by AMS1 is about 200 fold compared with its own weight. AMS-1 has a high affinity for water. One minute after water addition, AMS-1 absorbed more than 50% of its maximum water holding capacity (Figure 1). Maximum water absorbing capacity is recorded at 60 minutes after water addition and maintained thereafter.

Maximum water retention capacity of test soils increased with the increase of AMS-1 addition rate. Addition of 2% AMS-1 increased maximum water holding capacity of red and grey soils by 504% and 555%, respectively, compared to those of the un-amended soils. At the same amount of AMS-1 added, water-absorbing capacity of red soil was often higher than grey soil which could be explained that the red soil contain more clay than grey soil (Figure 2).

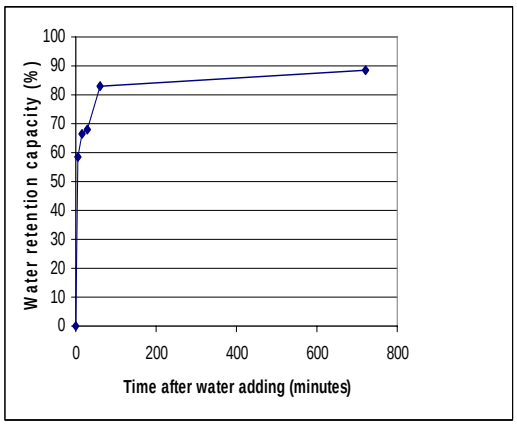

Figure 1: Water-absorbing capacity of AMS-1 with time

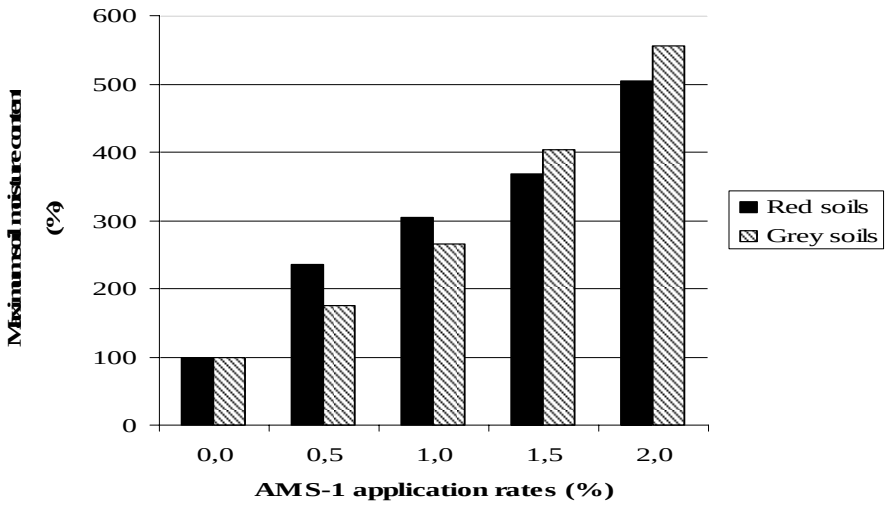

Figure 2: Effect of AMS-1 application rate on maximum soil moisture content of red & grey soils

Effects of AMS-1 application on wilting point of maize grown on grey and red soils.

Soil moisture content at wilting point for maize increased with the increase in AMS-1 application rates, ranging from 1.0% to 15.1% on grey soil and from 20.7% to 24.8% on red soil (Figure 3). With the application rate of 2%, AMS-1 increased water retention capacity most and hence prolonged the number of days to wilting to 16 days compared with the control value of 3 days where no AMS-1 was added.

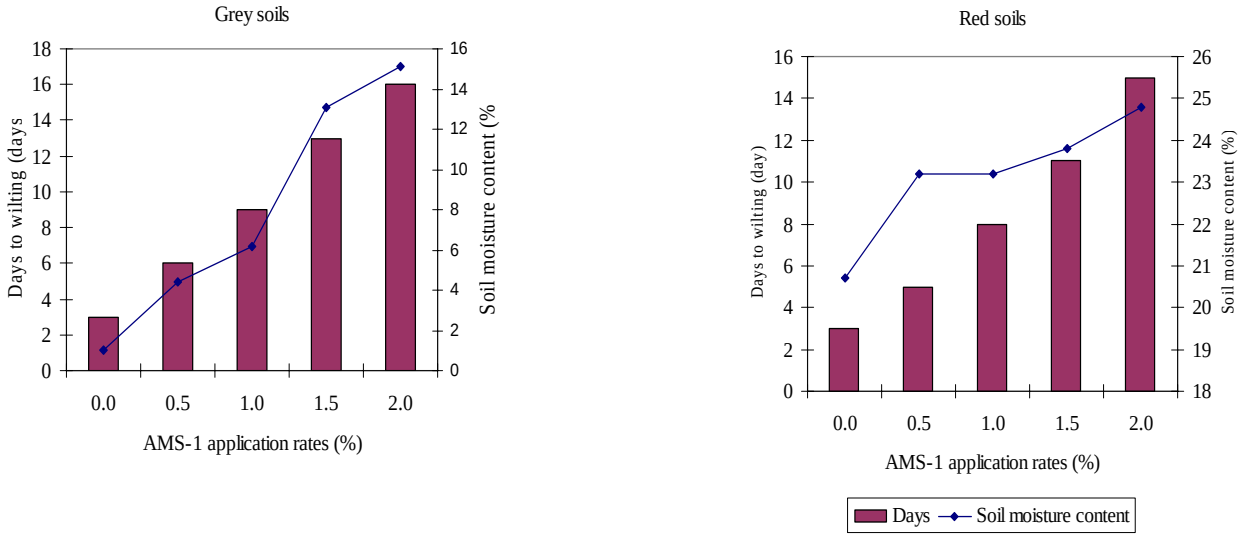

Figure 3: Effects of AMS-1 application rates on No. of days and soil moisture content at wilting point of red and grey soils.

Effect of AMS-1 application proportions on growing media

Water convolvulus (*Inpomoea aquatica*) and spinach (*Spinacia olaracea*) grown on cocopeat containing 0.5%-2.0% AMS-1 produced more biomass than the control. The application of 1% AMS-1 to growing media gave higher yield and at the same time saved 50% of the irrigation water amount (Figure 4).

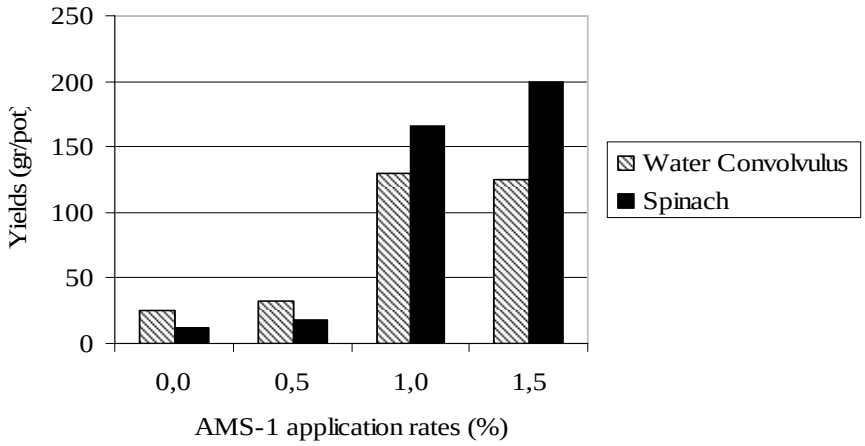

Figure 4: Effects of AMS-1 application rates on biomass of *Inpomoea aquatica* and *Spinacia olaracea*.

Effects of AMS-1 application on selected crops grown in field condition

Pak-Choi (Brassica chinensis)

Pak-Choi yield was significantly (P<0.05) increased with AMS-1 application. Fresh yield increased by 10.3 to 12.4% compared to the control. There was no significant difference in yield between the application rates of 30 and 40 kg AMS-1/ha. Economic efficiency was clearly demonstrated on a grey soil in Hoc Mon district and gave a net income of 2.4-4.2 million VND/ha/crop.

Cotton

Experiment of AMS-1 on cotton

In Xuan Loc district, Dong Nai province, cotton yield increased when AMS-1 was applied at the rate of 20, 25 and 30 kg/ha. There were significant (P<0.05) differences in yields between the control and experiments applied 25 and 30 kg/ha AMS-1 ranging from 2.69 to 2.48 ton/ha/crop (equivalent to 20.9-31.2%) and a high economic return.

Maize

Grain yield of maize increased by 16.5% to 20.7% when AMS-1 was applied to either a grey soil in Duc Hoa or a red soil in Long Khanh. Application of 30-40 kg AMS-1/ha led to an increase in net income of 1.5-2.5 million VND/ha.

Peanut

The effects of AMS-1 application were seen through a significant (P<0.05) increase in number of pods/plant and weight of grain on grey soil in Cu Chi district. Grain yield increased by 16.3% and 21.1% when AMS-1 was applied at the rate of 30 and 40 kg/ha, respectively.

Pineapple

The application of 40 kg AMS-1 per ha to an acid sulphate soil in Binh Chanh district resulted in a significant (P<0.05) increase of yield and saving 50% of

irrigated water. Farmers' income increased by 5.6 million VND /ha.

Coffee

In Daknong province, although the amount of irrigated water was reduced by 50% when AMS-1 was added, yield of coffee significantly ($P<0.05$) increased 20.3% and 23,7% with AMS-1 application rates of 40 and 60 g/tree, respectively.

Grape

Reducing amount of irrigated water by 25% and 50%, it significantly reduced grape yield. The application of AMS-1 (40 kg/ha) significantly increased grape yield (27.4%). There was an interaction between irrigation method and AMS-1 application.

Hoe flower (*Sophora japonica* L.)

Hoe flower (*Sophora japonica* L.) was planted in the highlands. The supplement of 20-60 g of AMS-1 per bush increased bud yield from 15.2% to 20.1% compared to the control. The income increased 6.3-11.0 million VND/ha/crop when AMS-1 was added.

- AMS-1 is degraded by soil microorganisms after 24 months, therefore AMS-1 is environmental-friendly.
- AMS-1, a bio-polymer, has a maximum water holding capacity, about 300-400 times of its weight.
- Application of AMS-1 to soil increased maximum water retention capacity and increased drought tolerance capacity of upland crops during water shortage period.
- At the addition rate of 25-40 kg/ha AMS-1 improved growth and yield of many upland crops. Crop yield increased by 10-23% and the income increased by 0.1-11.0 million VND/ha.
- The application of AMS-1 overcomes the disadvantage caused by water shortage at the end of summer-autumn season. High water-demanding crops such as grape and coffee could have their water requirement halved when AMS-1 was added. Income increased by 2.4-3.4 million VND/ha/coffee crop and 0.48-0.72 million VND/ha/grape crop.