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(54) METHOD OF PREVENTING LODGING OF PLANTS

(71) We, SHIONOGI & CO. LTD., a Japanese Body Corporate, of 12, 3-chome, Dosho-machi, Higashi-ku, Osaka, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of improving the resistibility to lodging of plants, particularly rice plants.

Lodging of rice plants is one of the critical problems in the cultivation of either paddy or upland rice plants. Such factors as excessive fertilisation, especially with nitrogen, deep irrigation, lack of sunshine, alone or in combination with each other, act to weaken culms of rice plants, and the culms thus weakened are lodged when subjected to external forces as wind or rain.

Once plants are lodged, intake of sunlight is restricted and absorption of water and nutrients is reduced by the occurrence of vascular bundle disorder. Thus, the lodging of plants not only results in a noticeable reduction of crop yields, but also makes harvesting work very difficult, especially when using machinery.

For preventing the lodging of rice plants, various forms of culture management have been employed in the past, such as controlling nitrogen fertilisation and irrigation of water and controlling potassium and phosphoric acid fertilisation. Furthermore, it is known that the breaking points on culms of rice plants are found generally at 5 to 10 cm. height from the ground, and these correspond generally to a point between the third and fourth nodes of the culms. Therefore to shorten the length between the nodes of the culms, application of specific plant hormones, for example 2,4-D, have been tried in recent years.

These methods are directed to strengthening the resistibility to lodging by controlling the growth of the rice plant. However, these methods are apt to cause decreased yields of rice, although the intended effect can be to a certain extent achieved. In particular it is

difficult to use a plant hormone properly for this purpose, because the timing for the application of the plant hormone is hard to determine.

According to the present invention, there is provided a method of improving the resistibility to lodging of rice plants and other plants which are susceptible to lodging which method comprises applying to the culms of the plants during their growth an emulsion containing from 0.8 to 50% by weight of one or more than one kind of the following polymers and copolymers: polyvinyl acetate, urea resins, acrylonitrile - butadiene copolymers, styrene - butadiene copolymers, butadiene-styrene - vinylpyridine copolymers, polyvinyl chloride, vinyl chloride - vinylidene chloride copolymers and polyacrylates.

The emulsions of synthetic latexes used in the method of the present invention may be selected in accordance with a variety of purposes, because various emulsions having different characteristics are available; for example, for specified purposes there may be chosen an emulsion which is quickly dried, an emulsion which forms tough film, one which forms a film at a low temperature, one which adheres well or one which is otherwise well suited to the particular purpose in mind.

The application of the emulsions to the plants may be effected by either spreading or spraying or scattering, either using or without using any apparatus or machinery. According to the present invention, as hereafter exemplified, fertilisation techniques are simplified, photo-synthetic ability of the plants is improved, cutting the plants with machinery is simplified and storm damage may be reduced, in consequence of which the application of the method of the present invention is expected to result in an increase of yield of the crop.

Following are some specific examples of the method of the present invention.

Example 1

An emulsion of a copolymer of styrene and butadiene having a viscosity of 25P, a specific gravity of 1.0, pH 8 and 45% by weight of

solids (I), an emulsion of a copolymer of butadiene, styrene and vinylpyridine having a viscosity of 25P, a specific gravity of 1.0 pH 11 and 40% by weight of solids (II) and an emulsion of a copolymer of butadiene and acrylonitrile having a viscosity of 25P, a specific gravity of 0.99, 40% by weight of solids and mean particle diameter of 0.05μ (III) were respectively prepared and they were used in the following experiment.

On 20th of May, seedlings of rice plants were transplanted to a paddy field and were cultivated according to a conventional method employed in Japan. On 20th of September, when the heads of the paddy rice plants had ripened and the culms of the plants had bent

slightly, the solution of each of the above described emulsions which had been diluted with twice the volume of water was sprayed on the paddy rice plants in the region of 1 to 30 cm. height from the ground. Two days later, the tops of the plants were reaped. The roots of the plants were secured so that they could be maintained in a horizontal position and the plants were cut at 50 cm. from their roots.

Weight was loaded on the tips of culms until they broke down and the resistance to breakdown of culms treated with each emulsion was determined. The results are shown in Table 1.

TABLE 1

Emulsion	Resistance to breakdown (gcm)/5 culms	
	at 3 cm from base	at 5 cm from base
Control (untreated)	200(100)	210(100)
(I)	300(150)	480(229)
(II)	600(300)	735(350)
(III)	600(340)	705(336)

Figures in parentheses are comparisons with the Control (=100)

As shown in Table 1, paddy rice plants treated with the emulsion (I) had 1.5 to 2.3 times as much resistance to breakdown as the untreated Control. Emulsion (II) and Emulsion (III) significantly strengthened the culms of the paddy rice plants, showing 3 to 3.5 times and 3.4 times, respectively, as much resistance to breakdown as the untreated Control. It is evident that application of Emulsions (II) or (III) can prevent culms of paddy rice plants from lodging 3 to 3.5 times more effectively than that of non-treatment.

As the head weight of paddy rice plants used in the above Example 1 was 15 g. per 5 culms, it may be calculated that the resistance to breakdown must be at least equivalent to a force of 300 gcm. on the culms of the plants at a distance of 3 cm. from the root or to a force of 225 gcm. at a distance of 5 cm. from the root, in order for lodging not to take place. Therefore, if left un-treated, the paddy rice plants would be expected to lodge sooner or later.

It was confirmed by this experiment that culms of paddy rice plants were readily strengthened by treatment with plastics emul-

sions and therefore the anti-lodging property of the plants were enhanced.

Example 2

An emulsion of a copolymer of butadiene and styrene having 40% by weight of solids, a mean particle diameter of 0.08μ and a viscosity of 16P (I), an emulsion of a copolymer of vinylidene chloride and vinyl chloride having 50% by weight of solids, a mean particle diameter of 0.2μ and a viscosity of 5 to 10P (II) and an emulsion of a copolymer of acrylonitrile and butadiene having 40% by weight of solids, a mean particle diameter of 0.05μ and a viscosity of 40P (III) were respectively diluted with ten times the volume of water. Paddy rice plants were treated by the same method as that described in Example 1.

With a view to showing the results which might be achieved under practical conditions, the spraying was carried out on the plants at the side only in this Example. Five days after the emulsion treatment, the tops of the plants were reaped and the weight sufficient to break down the culms of one stubble without the head was determined.

The results are shown in Table 2.

TABLE 2

Emulsion	Breakdown weight (g)/stubble	Elasticity
Control (un-treated)	49 g	—
(I)	51 g	+++
(II)	80 g	++
(III)	75 g	+++

Explanation of the Elasticity symbols:—

— None (no recovery from breakdown)

+ Slight (slight recovery from breakdown)

++ Fair (recovery from breakdown when weight is removed)

+++ Good (complete recovery from breakdown when weight is removed)

As shown in Table 2, the emulsions significantly improved the resistance to lodging of the culms of paddy rice plants even when applied to the plant body at the side only. Therefore, even if the emulsions are applied to paddy rice plants very roughly in practical use, lodging of the culms is significantly inhibited.

In this Example paddy rice plants were used the head weights of which were 45 to 53 g. per stubble. The plants were treated with emulsion when they were just about to lodge.

It was also proved in this Example that culms of paddy rice plants had enhanced elasticity by the treatment with these emulsions and so the anti-lodging property was remarkably intensified. No phytotoxicity due to the application of these chemicals was

found in the stools and leaves of the paddy rice plants.

Example 3

As a result of the two Examples described above, it was found that it was rather difficult to spray some of the tested plastic emulsions due to their having a viscosity which was slightly too high when diluted with water in amount from two to ten times the volume of the emulsion. Therefore, each emulsion described in Example 1 was diluted 20-fold and 50-fold in order that they could be sprayed more readily.

The experiment was conducted using the same method as that described in Example 1 and the resistance to breakdown of the culms treated with each emulsion was determined.

The results are shown in Table 3.

TABLE 3

Emulsion	Resistance to breakdown (gcm/7 plants)	
	20-fold	50-fold
I	1500	1220
II	1260	1500
III	1320	1400
Control (un-treated)	920	900

No great difference was found in resistance to breakdown of culms between the plants treated with the emulsions of copolymers in accordance with this invention at low concentration and at high concentration.

In the field, ten days after treatment with the emulsion, rice plants were lodged in Control (un-treated) plots while no plants were lodged in the treated plots.

- 10 The fact that culms of paddy rice plants are readily and definitely enhanced in their anti-lodging property brings remarkable increases in the yield of the plants. This invention contributes to the simplification of fertilisation technique in paddy rice cultivation, promotion of photosynthetic ability of paddy rice, simplification of harvesting work, especially with machinery and reduction of damage due to typhoons and other adverse weather conditions.

WHAT WE CLAIM IS:—

1. A method of improving the resistibility to lodging of rice plants and other plants which are susceptible to lodging which method comprises applying to the culms of the plants during their growth an emulsion containing from 0.8 to 50% by weight of one or more than one kind of the following polymers and copolymers: polyvinyl acetate, urea resins, acrylonitrile - butadiene copolymers, styrene-butadiene copolymers, butadiene - styrene - vinylpyridine copolymers, polyvinyl chloride, vinyl chloride - vinylidene chloride copolymers and polyacrylates.
2. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of polyvinyl acetate.

3. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a urea resin.

4. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of an acrylonitrile - butadiene copolymer.

5. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a styrene-butadiene copolymer.

6. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a butadiene - styrene - vinylpyridine copolymer.

7. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of polyvinyl chloride.

8. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a vinyl chloride-vinylidene chloride copolymer.

9. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a polyacrylate.

10. A method as claimed in any one of claims 1 to 9, wherein the treatment of the culms is effected at the growth stage of the plants during which the heads of the plants ripen and the culms slightly bend.

11. A method as claimed in claim 1 substantially as hereinbefore described in any one of Examples 1 to 3.

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The fact that culms of paddy rice plants are readily and definitely enhanced in their anti-lodging property brings remarkable increases in the yield of the plants. This invention contributes to the simplification of fertilisation technique in paddy rice cultivation, promotion of photosynthetic ability of paddy rice, simplification of harvesting work, especially with machinery and reduction of damage due to typhoons and other adverse weather conditions.

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2. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of polyvinyl acetate.

3. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a urea resin.

4. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of an acrylonitrile - butadiene copolymer.

5. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a styrene-butadiene copolymer.

6. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a butadiene - styrene - vinylpyridine copolymer.

7. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of polyvinyl chloride.

8. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a vinyl chloride-vinylidene chloride copolymer.

9. A method as claimed in claim 1 wherein the emulsion contains from 1 to 50% by weight of a polyacrylate.

10. A method as claimed in any one of claims 1 to 9, wherein the treatment of the culms is effected at the growth stage of the plants during which the heads of the plants ripen and the culms slightly bend.

11. A method as claimed in claim 1 substantially as hereinbefore described in any one of Examples 1 to 3.

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