

New Formulation of herbicides and Technology of their Application

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The purpose of formulation is to display herbicidal activity of active ingredient exactly and to control minus factors as much as possible such as crop injury, mammalian toxicity and selectivity. In the research for development new herbicides, to find out an active compounds are important, however to study of formulation is still more important in the practical stage.

To synthesize an excellent compound and study of formulation which display the compound's specificity certainly are very important fields in developing new herbicides. The relation between synthesis and formulaion are equal to relation between front wheel and back wheel on a bicycle and like as an active compound is crop and formulation is soil. Formulation is the final gate to determine the practical value of herbicide and good or bad on formulation influence the commercial value of herbicide. The role of formulation is not only to stabilize the compounds activity but also to simplify application methods.

For example, application methods of granule, LV with a rice trasplanter or a pipe duster and flowable formulation with a radio controlled boat or one point treatment in paddy field, and jumbo granule without entering in paddy field. Granulization has greatly contribute to the development and introduction of low land herbicides. Formulation types are very important to avoid the herbicidal influence to environment.

We conducted the model test about runoff of herbicides in inclined turfgrass field using granule and WP, the result was total amount of active ingredient of granule in run off water and in the soil was more less than that of WP formulation.

1. Formulation types

The purpose of formulation are as follows,

1. Exhibition of the highest activity of active ingredient
2. High selectivity between crops and

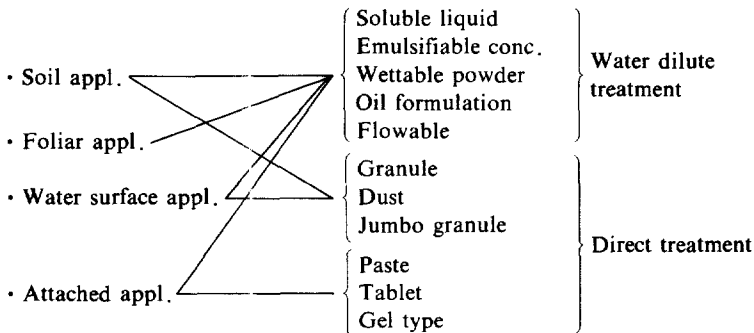


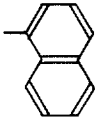


Fig. 1. Formulation and treatment method.

Table 1. Properties of surfactant radical

Severe lipoidic	Lipoidic	Hydrophilic	Severe hydrophilic
$-C_nH_{2n+1}$	$-CH_2OCH_3$	$-OH$	$-SO_3H$
$-C_nH_{2n-1}$	 $-OCH_3$	$-COOH$	$-COONa(K)$
 	$-COOCH_3$	$-CN$	
		$-NHCONH_2$	

weeds

3. Stability under longer stock
4. Safety to crop
5. Release control
6. Safety to environment
7. Saving of application labor

In the purpose, most important subject are labor saving and safety to environment.

Formulation types will be determined from the physico-chemical properties and physiologi-

cal properties. Main formulation types shows Fig. 1.

The important factor on formulation is choice of surfactant.

Surfactants are divided from physical properties, for example, anion, cation, nonion and amorphos and so on. In general, we normally use nonionic surfactant, this means that nonionic surfactant show a good affinity to active ingredient of herbicides and stabilization

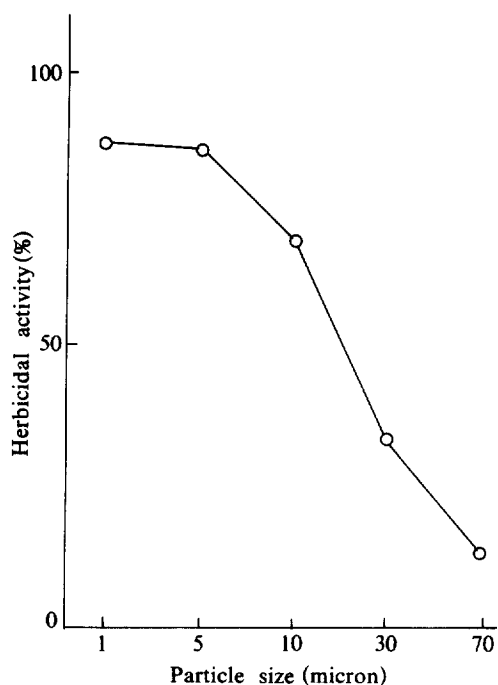


Fig. 2. Inhibition of different particle size of DBN against barnyard grass (*Echinochloa oryzicola*).

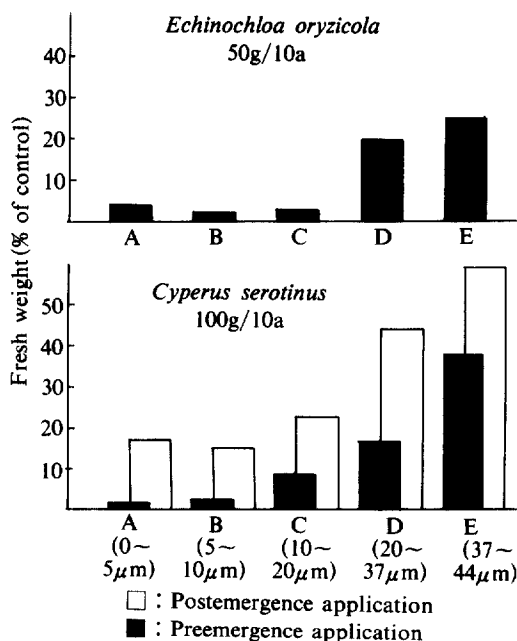


Fig. 3. Inhibition of different particle size of pyrazolate against *Echinochloa oryzicola* and *Cyperus serotinus*.

of herbicides. There are two types in the functional group, one is hydrophilic, the other is lipophilic (Table 1).

2. Particle size and herbicidal activity

Surfactants are important to show a high activity and to enhance the herbicidal activity, moreover is concerned in practical size of an active ingredient. There are limit only using surfactant to enhance the herbicidal activity. So we must check the herbicidal activity on particle

size of active ingredient. Fig. 2, Fig. 3 shows the herbicidal effects of DBN and Pyrazolate on several particle size. In the result, herbicidal activity increase gradually at small particle size, it can be obtained by enlarging the contact area and penetrating into weeds.

Particle size of an active ingredient is one of the important factor on formulation.

Particle size reflect directly on herbicidal effects of wettable powder and flowable, but is not so clear on granule.

Table 2. Herbicidal activity of granule and wettable powder of herbicides against *Echinochloa oryzicola* in paddy condition

Type of Symptom	Herbicide	Ratio of ED ₉₀ (granule/wp)
I. Leaf burn	bifenox	2.4
	chlormethoxynil	3.1
	chlornitrofen	3.3
	MK-129	2.4
	oxadiazone	2.0
II. Inhibition	benthiocarb	1.2
	butachlor	1.0
	dimepiperate	1.0
	mefenacet	1.0
	molinat	1.0
	thetylchlor	1.0
	piperophos	1.0
	pretilachlor	1.0
III. Inhibition and death	bensulfuron me.	1.7
	HW-52	2.0
	pyrazosulfuron et.	1.3
	quinclolac	1.0
	piributycarb	2.1
IV. Inhibition and stunt	bromobitide	1.3
	dymrone	1.3
	JC-940	1.3
V. Bleach	benzofenap	1.4
	pyrazolate	1.8
	pyrazoxyfen	1.4
VI. Blight	dimethmetryn	1.0
	prometryn	1.0
	simetryn	1.0

The number shows dose times of granule (ai) compared with wp(ai) treated in soil just after sowing of *Echinochloa oryzicola*.

3. Herbicidal activity of several kinds of formulation

Herbicidal activities of different formulation are change between foliar and soil treatment. In general, at foliar treatment, the order of effect are EC, flowable and WP. At soil treatment, the tendency are flowable, WP and granule.

Table 2 shows control of barnyardgrass with several herbicides of granule and WP. This table represent the required rate of granule in compared with the rate of WP. The herbicidal activities gradually decrease as a number is larger, as if bifenoxy and chlornitrofen remarkably.

The control of barnyard grass with three herbicides (MK-129, chlornitrofen and piributycarb) on flowable, WP and granule (Fig. 4). At 1 leaf stage treatment on barnyard grass, flowable is the most effective formulation in all of them. For example, ED₉₀ of controlling barnyard grass, flowable, WP and granule

of chlornitrofen shows 6g, 10g and 50g respectively. Another two herbicides has shown almost same results, the decrease of herbicidal activity on granule is very clear. The results which flowable shows a high activity means excellent diffusion in water and high adhesion to weeds. Other hand flowable shows good activity on pre-emergence treatment, this means that soil adsorption are made uniformly and the adsorption is soft, so that herbicidal effect increase comparatively.

4. Application method of flowable with radio controlled boat

The water diffusion of flowable shows very fast and application layer is formed uniformly. In generally, flowable used hand swing with bottle, however we tried radio controlled boat (Fig. 5). Length of the boat is 146cm, the width and height are 64cm and 40cm respectively, the weight is 5.8kg, exhaust capacity is 21.2

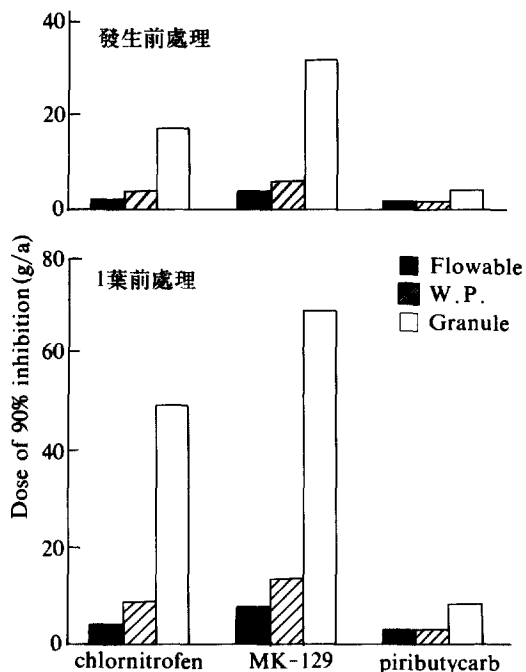
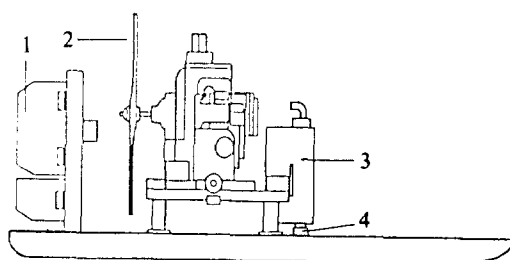
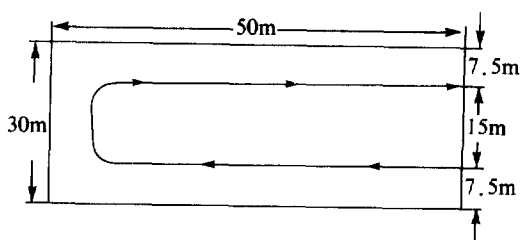


Fig. 4. Herbicidal effect against *Echinochloa oryzicola* by different type of formulation with chlornitrofen, MK-129 and piributycarb.



1 : Radder, 2 : Propeler,
3 : Flowable tank, 4 : Drop nozzle.

Fig. 5. Shape of radio controlled boat.



Trace of radicon boat moving

Table 3. Herbicidal activity of flowable and granule on paddy field

Formulation	Dose (/10a)	Active ingredient (/10a)		Dry Wt. (g/m ²)						% of CK
		B.C.	B.S.M	A	B	C	D	E	Total	
Flowable	600ml	120	3	0	0	0.7	0.3	0	1.0	1.1
	1000	200	5	0	0	0	0	0	0	0
Granule	2kg	140	3.4	2.1	0	2.2	0.5	0	4.8	5.6
	3	210	5.1	0.7	0	0.6	0	0	1.3	1.5
Hand Weeding	-	-	-	0	0	0	0	0	0	0
CK (%) (Untreated)	-	-	-	62.5	3.1	8.8	1.8	1.8	85.8	100

Application method of flowable and granule was done radiocontrolled boat and scatter machine respectively.

B.C. : Benthocarb, B.S.M : Bensulfuron methyl
A : *Echinochloa oryzicola*, B : *Cyperus difformis*, C : *Scirpus juncooides*,
D : *Monochoria vaginalis*, E : *Rotala indica*

cc, output is 1.1ps, fuel capacity is 0.55 L, and speed is about 2.08m/s. We used a propelar as pushing power and prepared light foaming styrol as body, so deep draft in water is about 1.5cm. We conducted that trial in a direct seeded paddy field which have an area 30a and irrigated about 5cm at 2 weeks after seeding, spray volume of flowable are 0.6 and 1 litter per 10a. We finished application with the boat 210sec. (70sec./10a). Table 3 shows

the herbicidal activities at 20 days after treatment compared with granule.

The 1 litter treated plot of flowable completely killed weeds and moreover the 0.6 litter plot is more effective than the 3kg treated plot of granule. This result means the application method of flowable with the radio controlled boat will bring saving of application labor and a stability of hebicidal activities.