Utilization of Helicopter for Plant Protection

NAOKI HATAI

Entomologist, Department of Plant Pathology and Entomology,
National Institute of Agricultural Sciences

Aerial application of pesticides to control diseases and insect pests of crops is operated only by helicopter in Japan. In the past, tests were carried out to ascertain the possibility of using fixed-wing airplane on rice paddy field, pasture land and forest area with effectual results. However, it was concluded that it is much more convenient to use helicopter than fixed-wing plane because of the following reasons: 1) shortage of landing space for fixed-wing plane near by the fields, 2) too many obstacles on and around the fields to be treated, and 3) higher utility of helicopter for the commercial companies who are supplying helicopter for agricultural uses.

Helicopter and apparatus

The types of helicopters used at present are Bell 47-D1, 47-G, 47-G2, 47-G2A, Bell-Kawasaki 47-G3B-KH4 and Hughes 269B. All of the Bell type helicopters are manufactured in Japan by Kawasaki Aircraft Inc., but Hughes helicopter is imported. Available for agricultural uses are about 140 helicopters which belong to commercial air-service companies and the Agricul-

Table 1. Use of aircraft in agriculture by year (in hectare)

Year	Fixed-wing airplane			Helicopter		
	Agriculture	Forestry	Fishery	Agriculture	Forestry	Fishery
1953	—	203	—	—	—	—
1954	—	4,900	—	—	1,685	—
1955	—	26,352	—	—	35,223	—
1956	—	425	—	—	14,761	—
1957	—	—	—	—	240	—
1958	—	—	—	1,045	—	—
1959	—	—	—	4,244	21,974	—
1960	—	200	—	17,915	114,256	—
1961	—	—	—	101,231	81,142	—
1962	—	—	—	274,757	128,137	—
1963	—	—	—	520,309	135,065	—
1964	180	—	—	695,452	213,249	—
1965	—	—	—	844,466	296,042	800
1966	—	—	—	852,377	270,205	700
1967	—	—	—	969,321	361,677	—
1968*	—	—	—	1,129,688	365,500	—

Note: * estimation

tural Aviation Association.

As to the apparatuses for application of agricultural chemicals, there are sufficient quantity of duster kits, sprayer kits, granule applicator kits, rodent poison bait applicator kits and special ULV sprayer kits (Ultra Low Volume Spray) available which are all made in this country. Especially, granule applicator and ULV sprayer kits are designed in Japan.

Use of aircraft in agriculture

Use of aircraft in agriculture is shown in Tables 1 and 2. As shown in Table 1, fixed-wing planes were used in forestry to control bark beetles from 1953 to 1956 when the supply of helicoplers was still insufficient. In 1964, Piper Pawney was tested on pasture land for sowing seeds and applying fertilizers. Fixed-wing planes are still utilized in forestry area for aerial survey.

As it is obvicus in Table 2, helicopters are used mainly to control rice blast disease and rice leafhoppers which are the vectors of virus diseases in rice fields, and rodent control in forestry.

Recommended major items in plant protection

Practical use of helicopter in plant protection is limited to the following items.

(1) Control of diseases and insect pests of rice plant.

a. Rice stem borer, *Chilo suppressalis*.

b. Rice leafhoppers, *Nephotettix* spp.

Table 2. Control of diseases and insect pests by year (in hectare)

Items	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968*
Rice blast	1,045	4,041	13,427	51,881	149,287	226,063	184,068	206,947	186,763	129,136	175,225
Rice leafhoppers	—	—	2,733	41,918	89,406	178,325	203,661	209,144	220,728	337,201	389,896
Rice stem borer	—	203	1,755	5,510	33,437	78,404	68,254	59,217	70,745	77,245	51,894
Disease & insect**	—	—	—	—	—	30,724	226,729	355,629	362,119	409,043	486,413
Others	—	—	—	—	765	1,646	1,455	1,810	1,244	1,539	3,500
Sub-total	1,045	4,244	17,915	99,309	272,895	515,180	684,167	832,744	841.599	954,174	1,106,928
Apple disease & insect	—	—	—	1 922	1,010	473	1,798	1,395	1,010	2,351	2,900
Citrus disease & insect	—	—	—	—	152	177	3,040	6,040	5,901	8,675	15,270
Other fruit trees	—	—	—	—	—	—	—	137	36	—	340
Sub-total	—	—	—	1,922	1,162	650	4,833	7,572	6,947	11,026	18,510
Tea and mulberry	—	—	—	—	560	483	403	861	674	917	2,300
Vegetable	—	—	—	—	140	3,996	5,589	2,489	2,487	2,714	1,450
Sub-total	—	—	—	—	700	4,479	5,992	3,350	3,521	3,631	3,750
Ticks in pasture	—	—	—	—	—	—	455	800	396	490	500
Total (Agriculture)	1,045	4,244	17,915	101,231	274,757	520,309	695,452	844,466	852,463	969,321	1,129,688
Forestry disease & insect	—	1,210	2,711	468	11,650	17,776	19,104	28,019	32,292	39,093	
Rodent control	—	20,764	111,485	80,674	116,487	117,285	193,874	277,566	233,692	313,342	
Weeding, etc.	—	—	—	—	—	4	271	457	4,222	9,242	
Total (Forestry)	—	21,974	111,256	81,142	128,137	135,065	213,249	296,042	270,206	361,677	365,500
Fishery	—	—	—	—	—	—	800	700	—	—	—
Total	1,045	26,218	132,371	182,373	402,894	655,374	909,501	1,141,208	1,122,583	1,330,998	1,495,188

* Estimation

** This means to control disease and insect pest at same time by mixing fungicide and insecticide together.

c. Rice leaf beetle, *Oulema oryzae.*
d. Black rice bug, *Scotinophara lurida.*
e. Rice blast, *Pyricularia* oryzae.
f. Rice sheath blight, *Pellicularia sasakii.*
g. Yellow dwarf (vector; *Nephotettix* spp.)
h. Rice dwarf virus (vector; *Nephotettix* spp.)
i. Rice stripe virus (vector; *Laodelphax striatellus*)
j. Rice black-streaked dwarf virus (vector; *Laodelphax striatellus*)
k. Disease & insect: This means to control disease and insect pest together at the same time by mixing fungicide and insecticide. For instance, control of stem borer and blast, stem borer and leafhopper, blast and leafhopper, etc.

(2) Control of diseases and insect pests of field crops.
a. Cabbage armyworm, *Mamestra brassicae*, of cabbage.
b. Virus of *Brassica* spp. (vector; aphid)
c. Sweetpotato leaf worm, *Aedia leucomelas*, and tobacco cutworm, *Prodenia litura* of sweet potato.
d. *Botrytis allii* of onion.
e. Wheat scab, *Gibberella zeae.*

(3) Control of diseases and insect pests of fruit trees.
a. Apple leaf miner, *Lithocolletis ringoniella*, of apple.
b. Red mites of apple.
c. Leaf rollers of apple.
d. Blossom blight, *Sclerotinia mali* of apple.
e. Red mites of citrus.
f. Aphids of citrus.
g. Melanose, *Diaporthe citri* of citrus.
h. Scab, *Elsinoe fawcetti* of citrus.

(4) Control of insect pests of tea.
a. Smaller tea tortorix, *Adoxophyes orana.*
b. Tea leaf roller, *Caloptilia theivora.*
c. Tea cochlid, *Phrixolepia sericea.*
d. Red mites of tea.

(5) Weed control in rice paddy field.
(6) Drying of rice plants before harvesting.
(7) Sowing seeds.
a. Rice seed at rate of 60–120 kg per hectare.
b. Milk vetch seed at rate of 20–40 kg per hectare.

(8) Application of fertilizers on rice field, pasture land and forestry.

(9) Control of insect pests of mulberry tree.
a. Mulberry pyralid, *Margaronia pyloalis.*
b. Mulberry small weevil, *Balis deplanata.*
c. Mulberry leaf beetle, *Fleutiauxia armata.*
d. Mulberry sucker, *Anomoneura mori.*
e. Brown tail moth, *Euproctis similis.*
f. Rhombic-marked leafhopper, *Hishimonus sellatus.*

(10) Control of ticks of cattle in pasture land.

(11) Growth acceleration of seaweed culture.

(12) Control of diseases and insect pests of forestry.
a. Pine caterpillar, *Dendrolimus spectabilis.*
b. Gypsy moth, *Lymantria dispar.*
c. Japanese larch pyralid, *Cryptoblabes laricana.*
d. Sugi leaf beetle, *Basilepta pallidulum.*
e. Sugi needle gall midge, *Contarinia inouyei.*
f. Pine bark beetles.
g. Shoot blight, *Guignarida laricina.*
h. Rodent control.

Recommended practices in agricultural aviation

All of the helicopters available for agricultural uses are as mentioned above kept under the control of the Agricultural Aviation Association. Therefore, all apparatuses or applicators should be approved by the association before their use. The crew, pilots and mechanics, have to pass the examination given by the association before they can serve in this field.

Dangerous places for helicopter to fly should be excluded from the area to be treated. Ground obstacles should be marked so as to be detected easily by the pilot.

As regard pesticides, only the registered pesticides are permitted to be used but highly toxic materials are prohibited for use in aerial spraying. Any pesticide highly toxic to fish is also banned.

The standard rate of application is; 20–30 kg per hectare in case of dusting, 20–40 kg per hectare in case of granule application and 20–60 liter per hectare in case of spraying. In case of ULV spray, it is recommended to apply 0.5–2 liter per hectare.

In Japan, it is recommended to fly at the

speed of 30–40 MPH with height of 5–10 meters above the crop. The effective swath width in such case will be 18–20 meters.

Organization to execute aerial application of pesticides

Since the number of the helicopters is still insufficient to cover the whole demands of the farmers at present, helicopters available are registered at the Agricultural Aviation Association and kept under its control.

Farmers who wish to utilize a helicopter in plant protection will organize an executive team and send their request to the prefectural government through the town or village office. Each prefectural government will submit the request to the Ministry of Agriculture and Forestry and then the ministry will order the association to prepare a year-round flight schedule to cover the whole country considering the availability of helicopters. When this schedule is ready and approved by the ministry, it will be sent through the Executive Committee organized under the prefectural government to the executive team. On the other hand, this schedule will also be given to air-service companies and each company will make arrangement with organizations concerned as shown in the following organization map.

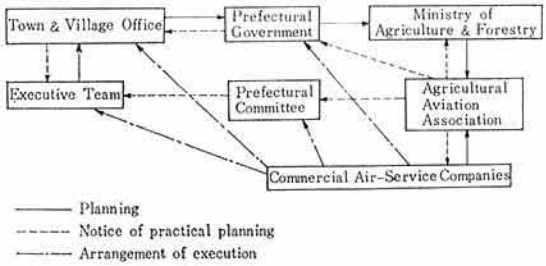

Fig. 1. Organization Map.

Costs of aerial spraying and dusting

Since all helicopters are kept under the control of the association, operating costs are set by the committee of the association as follows; (these expenditures exclude costs of pesticides)

(1) Dusting and application of granules:
U.S. $3.90 per hectare for applying 30 kg per hectare.
U.S. $3.60 per hectare for applying 25 kg per hectare.
U.S. $3.35 per hectare for applying 20 kg per hectare.

(2) Spraying:
U.S. $4.17 per hectare for applying 30 liter per hectare.
U.S. $9.44 per hectare for applying 80 liter per hectare.

Fig. 2. Aerial dusting to control rice blast.

The above mentioned costs are set only as a standard and they are variable according to the area to be treated.

Newly developing technique

One of the newly developing techniques and the most promising is the ULV spray or Ultra Low Volume spray which is to apply only 0.5 to 2 litters of spray liquid per hectare. At present, tests are carried out to control rice blast disease, rice sheath blight disease, rice stem borer and rice leafhoppers which are the vectors of virus diseases. If this technique is established, the cost of operation of helicopter will become much cheaper and drift hazard of pesticide will be reduced.