韓國 作物學會誌 第12號(1972. 12)
J. Korean Soc. crop. Sci. Vol. 12

Studies on the Fruiting Phase of Rape Under the Different Cultural Conditions

B. M. Kae

Mokpo Branch Station, Crop Experiment Station, Mokpo, Korea

SUMMARY

The fruiting phase of rape under transplanting and direct-sowing conditions has been studied at Mokpo during the 2 years period from 1970 to 1971. Two varieties, Yudal and Miyuki were used in this study. The planting space and sowing time were also incorporated into this study. The results could be summarized as follows :

1. The plant tape of rape was nearly umbrella-shaped of all, but has changed to the laid elliptical-shaped, broadly ovate and spindle-shaped under different varieties and cultural conditions in the plant diagram(Fig. 2).
2. The length of the primary branches for each nodes had a tendency to the symmetric apical curve with the apex at the upper 10-12th node in the transplanting. but to the upper bias apical curve with the apex at the upper 5—7th node in the dense-sowing(Fig. 3).
3. The ear of main stem was longer, more pods, heavier 1,000 grains and more grain yield than ear of primary branches of all, Especially, as for that, the rate of yield constitution per plant in the direct-sowing was higher than in the transplanting(Fig4, 5, 6, 7, 8, 9).
4. The ear-length of the primary branches for each nodes had a tendency to the relatively slowly apical curve with the apex at the upper 3-4th node in the transplanting, but to the lower bias apical curve with the apex at the upper 2nd node in the dense-sowing. Especially, the possibility of growth at the lower ears was few in the early variety (Fig. 4).
5. The number of pod per ear on the primary branches for each nodes had a tendency to the curve of ear-length with the apex at the upper 5-8thnode in the transplanting and at the upper 4-5th node in the dense-sowing (Fig. 5). Accordingly, a high possitive correlation was found between the ear-length and number of pod per ear (Table 2)
6. In the transplanting, the high rate of effective ear was from the upper nodes to the 12th node, but below the 16-17th nodes was ineffective. However, in the early dense-sowing the high rate of effective was to the 7th node. but below the 10th nodes was ineffective. Especially, in the early variety has difficult to secure of pod-numbers for ineffective of the lower nodes(Fig. 6.).
7. The density of pod setting of the ear of main stem was the longest of all ears, and the lower nodes were, the shorter it became. That had a tendency to the evidently apical growth. However. in the early variety, it was lengthened according to growth of ear-length(Fig. 7).
8. The pod-length of the medium nodes was longer than the upper and lower, and the possitive correlation between pod-length and numver of grain per pod was very high(Table 2.).
9. In the grain yield per node of primary branches, the most yielding node of transplanting was the

upper 9th node, of dense-sowing 4-5th node(Fig 8.), and the possitive correlation between grain yield per node and ear-length or number of pod per ear was very high(Table 2).

10. The grain yield of ear of main stem was higher than that of primary branches in the percentage of dependence for grain yield per plant. The limint node of 50% of dependence to cumulative grain yield per plant was the upper 7-8th node in tranplanting, in the early dense-sowing 4—5th node, and in tke late dense-sowing-3th node(Fig. 9).
11. In the weight of 1,000 grains the lower nodes were, the lighter it becames in dense-sowing. Therefore, this was also lighter than in the transplanting to the average weight of 1,000 grains. (Fig. 10.).
12. The oil content of grain at the medium nodes was low in the early variety, but at the ear of main stem and upper lst node it was extremely high(Fig. 11.).

ABSTRACT

The fruiting phase of rape was studied at Mokpo under the transplanting and direct-sowing conditions. Two varieties, Yudal and Miyuki were used in this study. The ear of main stem was longer. more pods, heavier 1,000 grains end more grain yield than ear of primary branches of all. The branches of the upper 5-9th nodes in the transplanting and of the upper 4-5th nodes in the dense-sowing have many pods, high rate of effective ear and much grain yield per node. The possitive correlation between grain yield per node and earlength or number of pod per ear was very high. The density of pod setting of the ear of main stem was the longest of all ears, and the lower nodes were, the shorter it became. The pod-length of the medium nodes was longer than the upper and lower, and the possitive correlation betwen pod-length and number of grain per pod was very high. The limit node of 50% of dependence to cumulative grain yield per plant in the eraly dense-sowing was more gone up to the 3 nodes of the upper than in the transplanting. In the case of the weight of 1,000 grains the lower nodes were, the lighter it becames in the dense-sowing. The oil content of main stem and lst node was extremely high in the early variety.

INTRODUCTION

Takezaki [9,10] reported the fruiting phase of rape, morphological characteristics of rape varieties and compensationality of yield component under the different sowing time and planting space, but this was quite different to our cultural conditions of rape. Therefore, by the present writer[6] our cultural condition of rape was modified as transplanting in the autumn or spring and early or late direct dense-sowing, and reported on flowering habits of those. Continuously, for this tiem, we measured their plant-type, and by developing primary branch. the elongation of ear, secure of pods, fullness of pod and dependence of grain yield were increasing and investigated the compensation conditions of mutual action in each cultural conditions. From those facts we could be obtained effective basic meterials: (1) for the reference of the rape breeding work and improvement of cultivation practices in the future, (2) for the attempt to establish the standard on the measurements of various characteristics in those trials.

METERIAL AND METHOD

Investigations were carried out on sandy loam soil of the Mokpo Branch Station, Crop Experiment Station at Mokpo from 1970 to 1971.

The varieties[2] of rape used in this experinents were "Yvdal" and "Miyuki". "Yudal"[7] is a late maturing with heavy ear variety and "Miyuki"[5] is an early maturing with many branches variety.

The kinds of treatment were as Table 1 which used a split-plot experimental design with three replication; the seeding on the nursery was on September 20, the transplanting on October 30 or March 5, the direct dense-scwing on September 20.

or October 30.

The planting space in the transplanting was 50cm ×30cm, the direct dense-sowing with two plants per hill 50cmx15cm, Fertilizers[2] were applied compost of 4kg per 3.3m² and 150:30:30g per 3.3m² as N:P_2O_5:K_2O respectively at the nursery, and in the field compost of 1,000kg per 10a and 3.3:8:8 kg per 10a as N:p_2O_5:K_2O respectiyely for basic dressing and for additional side dressing applied N of 6.7kg per 10a on March 5. However, nitrogen of the transplanting in spring were applied 6.7kg per 10a for basic dressing.

Table 1. Kinds of treatment

Treatment	Sowing date	Trans-planting date	Planting space			
			Row width	Within row	No. of plant per hill	No. of plant per 10a
A-Tr	Sept. 20	Oct. 30	50cm	30cm	1	6,666
S-Tr	〃	March 5	〃	〃	〃	〃
E-D	〃		〃	15cm	2	26,666
L-D	Oct. 30		〃	〃	〃	〃

We counted and measured the culm length, internode length, and on each node the primary-branch length, ear length, pod number, weight of grain yield, weight of 1,000 grains and percentage of oil content in grain taken from 45 plants of representative individual in each plot. Moreover, we counted the number of average ovule and grain for ecognition of percentage of fertility on the each nodes.

Some meteological factors [1,2] during growing period of the rape plant are shown in Figure 1 which we compared to average year from 1910 to 1970.

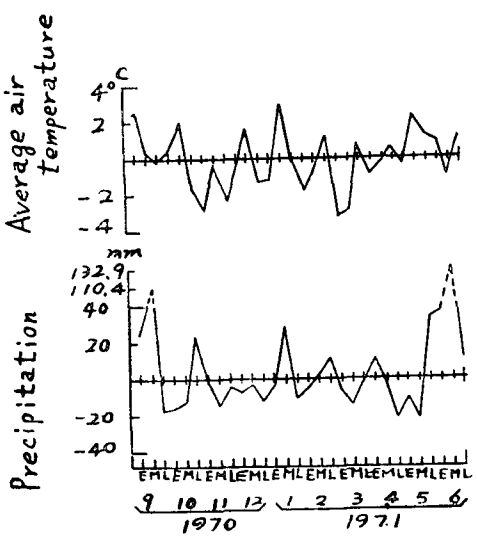

Fig. 1. Some meteological factors during gowing period of the rape plant (Mokpo)

RESULTS

1. Shoot-growing of the primary branches:

The number of the effective primary branch were shooted most as 23 branches and grown best in the autumnal-transplanting of "Yudal", but in th spring-transplanting decreased by 26% than that. Accordingly, the vigour of a plant was a relatively small in this. However, if we observed the plant type with plant diagram as Figure 2, the behavior of "Yudal" would be nearly identical in both autumnal-transplanting and spring-transplanting as nearly broadly ovate[4] was drown; the best developing branches were 9th and 10th nodes from upper, and from those nodes the upper or lower the branch was, the shorter it becames by degrees. In the early dense-sowing, the plant type was relatively huge because the numbers of the effective primary branch were decreased by 43% than the autumnal-transplanting but the height of plant was elongated by 36% than that. Accordingly, if we also observed the plant type with plant diagram for this, it would be drawn as nearly spindle shaped[4]; the best developing branches were 6th and 7th nodes from upper, and from those nodes the upper or lower the branch was, the shorter it becames by degrees.

In early variety "Miyuki", the number of effective primary branch of autumnal-transplanting were not only decreased by 17% than that of "Yudal", but also the vigour of a plant was a relatively small.

However, the differences among cultural conditions were smaller by 10% than that of "Yudal., respectively. And, the plant type with plant diagram was observed to the laid elliptical-shaped because t was lower the height to width that of "Yudal" according as the primary branches were lengthened.

The tendency to developing of primary branch for each nodes in autumnal-transplanting of "Yudal" is shown in Figure 3 which was the continuous curve, It indicated the nearly symmetric apical

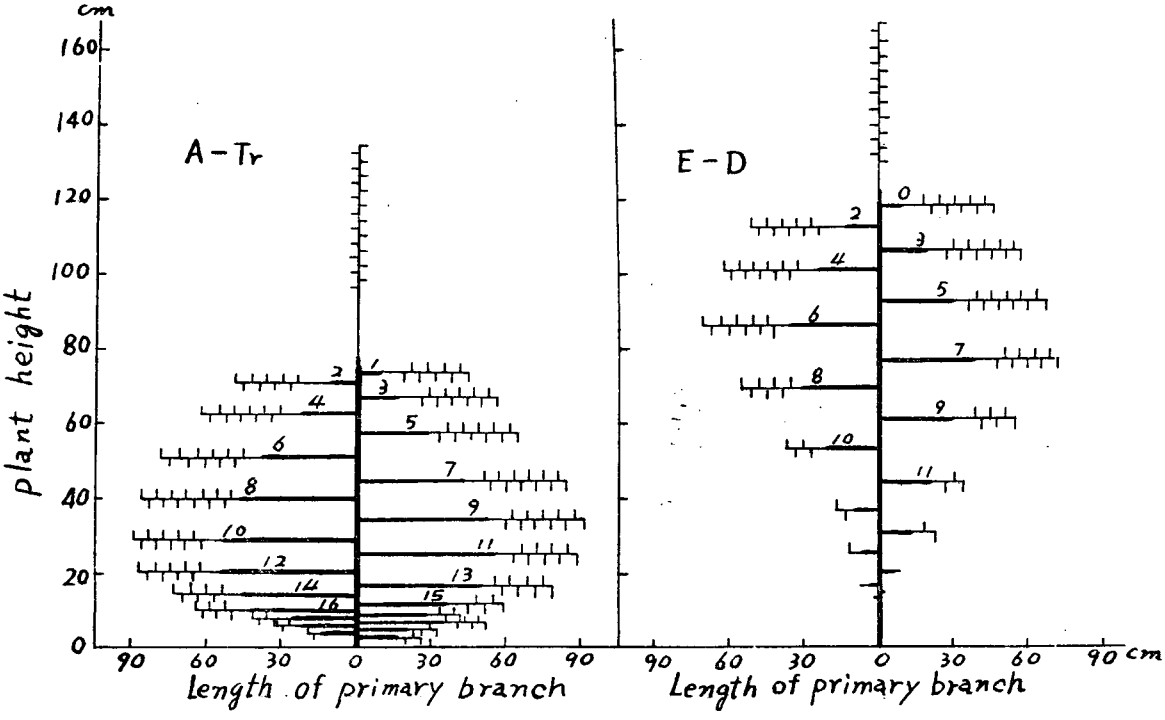

Fig. 2. Plant diagram of rape variety "Yudal" for modified growth and fruiting habit (1971 Mokpo)

curve with the apex at 12th node from upper of primary-branch length of 55cm that from this node the upper or lower the branch was, the shorter it becames by degrees. But early dense-sowing indicated the radical shorted symmetric apical curve with the apex at 7th node of primary-branch length of 39cm and late dence-sowing more radical shorted curve with the apex at 5th node of primary-branch length of 43cm.

The tendencies of "Miyuki" would be nearly similar to "Yudala but only the apex locatad on upper of 2-3 nodes than "Yudal". About the proportio-of ineffectvie branches to total branches the spring tran nsplanting of 55% and early dense-sowing of 61%was higher than autumnal transplanting 28%, But early dense-sowing of Miyuki was low as 38%

2. Ear length and Pod number:

The ear of main stem was longer, more pods than ear of primary branchse of all. The ear length of main stme of 53-59cm in "Yudal" was longer by 12cm than "Miyuki" and also pod number of 50-62 pods settled on it "Yudal" was more by 14-17 pods than "Miyuki".

But pod number settled on it of late dense-sowing in "Miuki" was decreased by 12% than autumnal-transplanting in "Yudal" and it in Yudal was decreased singnificantly by 29% than this in "Miyuki"

The ear length of primary branches in the autumnal -transplanting of "Yudal" is shown in Figure 4 which indicated the nearly symmetric curve with the apex at 4th node from upper of ear length of 42cm that from this node the upper or lower the ear was, the shorter slowly it becames as the tendency to developing of primary branch. The apex of continuous curve in the spring-transplanting located on 3th node from upper of ear length of 36cm as the nearly tendency of autmnal-trnasplanting, but

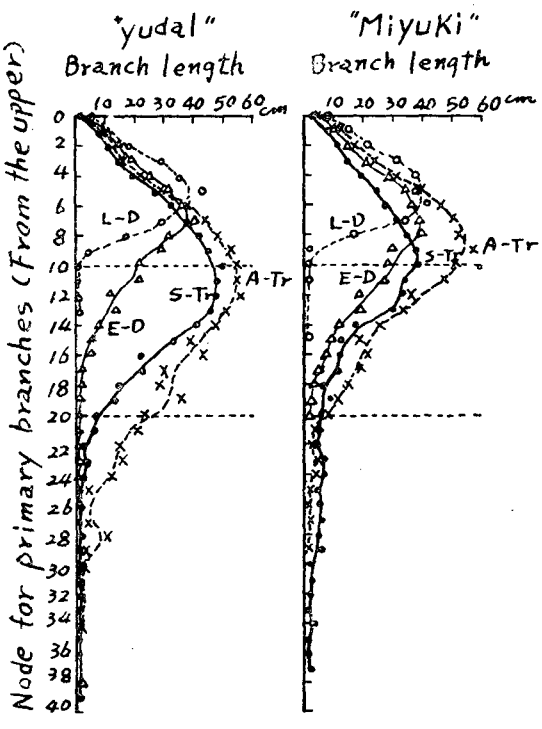

Fig. 3. Comparison to the length of primary branches for each nodes per plant (1971)

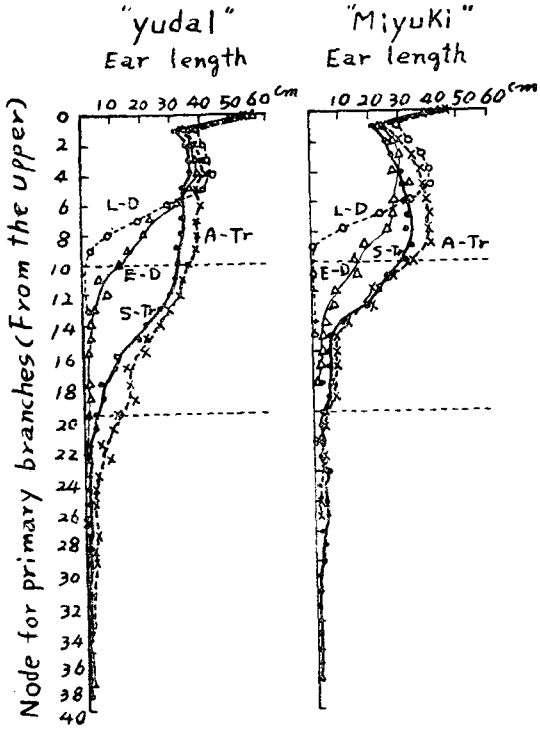

Fig. 4. Comparison to the ear length for each nodes per plant (1971)

t in the early dense-sowing on 2nd node from upper of ear length of 38cm as this deceased slowly from it to 7th node and dacreased remarkably below 8th node. This tendency was more remarkably in the late dense-sowing. Also the behaviors of "Miyuki" would be nearly similar to "Yudal" but only the apex located on the lower of 2-5 nodes than "Yudal" as it decreased remarkably below this node.

The continuous curves of pod number of the primary branch are shown in Figure 5 which weer similar to the curve of ear legtth. Accordingly the ear length and pod number per ear were very highly possitive correlationship as Table 2. That is, the apex of it in autumnal-transplanting of "Yudal" located on 8th node from upper of 39 pods and it in spring-transplanting on 5th node from upper of 32pods that from this nodes the upper or lower the pod number per ear was, the fewer slowly it becames respectively. On the one hand, it in early dense-sowing located on 5th node from upper of 33pods and it in late densesowing on 4th node from upper of 31 pods that decreased very remarkably below this node. Also the behaviors of "Miyuki" would be nearly similar to the curve of ear length but only the apex located on thd uper of 1-2 nodes and was fewer by 5-7pods than "Yudal" as it decreased very remarkably below this node.

The percentage of effective ear namber per plant for each nodes is shown in Figure 6. Transplanting of "Yudal" settled the many pods on effective ears over 96% from ear of main stem down to 12th node but it decreased remarkably below this node and were nearly ineffective below 16-17th node. The early dense-sowing settled on many pods from upper down to 7th node but it decreased very remarkably below this node and effective limit node

Table 2. The simple correlation coefficents between the main characteristios of primary branch under some rape varieties and cultural conditions (1971).

Between characteristics	Varieties	Transplanting inthe autumn	Transplanting in the spring	Early dense-sowing	Late dense-sowing
Ear length and pod number per ear	Yudal	0.980**	0.985**	0.983**	0.992**
	Miyuki	0.989**	0.986**	0.971**	0.951**
Pod length and Grain number per pod	Yudal	0.999**	0.999**	0.997**	0.998**
	Miyuki	0.994**	0.996**	0.993**	0.989**
Weight of grain yield and Ear langth	Yudal	0.942**	0.969**	0.962**	0.986**
	Miyuki	0.958**	0.950**	0.950**	0.892**
Weight of grain yield and Pod number per ear	Yudal	0.959**	0.968**	0.991**	0.968*
	Miyuki	0.940	0.949	0.947	0.636
Weght of 1,000 grains and Oil content of grain seeds	Yudal	0.071	0.385	0.178	0.171
	Miyuki	−0.176	−0.141	0.538*	−0.500

* Significant at the 5% level　　** Significant at the 1% level

of it was at 10th node, The late dense-sowing was more extreme than early Pense-sowing; as it settled on many pods from upper down to 5th node but effective limit node of it was at 7th node just below. Comparatively, the tendencies among cultural conditions of "Miyuki" would be nearly similar to "Yudal" but only effective limit node over 90% that settled on many pods located on upper of 2-3 nodes and also the effective limit node on upper of 2-5 nodes than "Yudal".

The density of pod setting is shown in Figure 7. In all cultural conditions in "Yudal", it of ear of main stem was the longest of 71-82 mm and the lower it of ear of branches was, the shorter this becames. But this in "Miyuki" were long rather than ear of main stem as the elongation of ear length except the early dense-sowing.

Ear of transplanting settled relatively rare pods because this was longer than the early dense-sowing. This pods was settled more rarely by the late dense-sowing. It of "Yudal" was longer than "Miyuki" but the variation of pod setting by sowing time and density of planting was a few degree.

3. Pod length and Grain number per pod:

The pod length and grain number per pod were very highly possitive correlationship as Table 2. The pod length of late dense-sowing was longer than early dense-sowing, it of "Yudal" was shorter

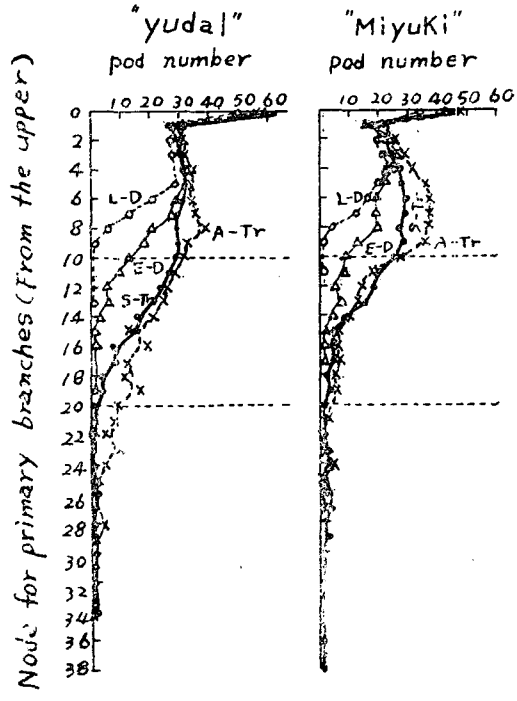

Fig. 5. Comparison to the pod number per ear for each nodes per plant (1971)

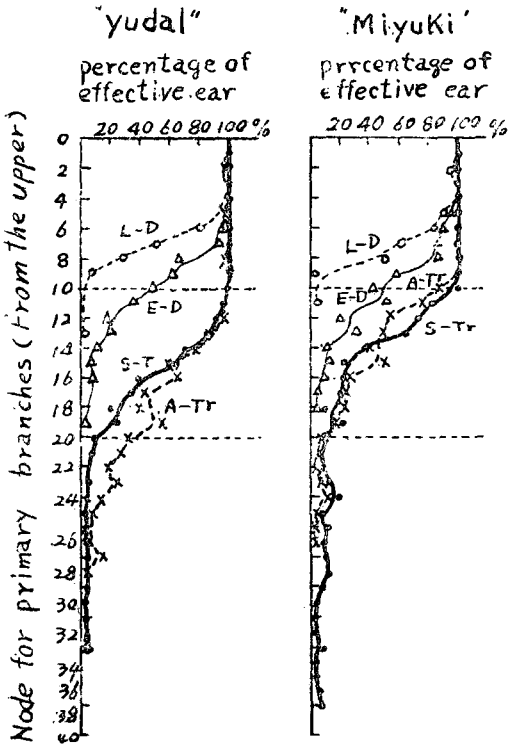

Fig. 6. Comparison to the percentage of effective ear for each nodes per plant (1971)

than "Miyuki" but grain per pod had many rather than "Miyuki". Especially, the pod length and grain number per pod of main stem were shorter and tewer than it of branches. Regarding to the pod length for each nodes the medium nodes of the fransplanting and early dense-sowing wa longer than upper nodes. Accordingly, the grain number per pod has many on the medium nodes.

The percentage of fertility was 80-85% as there was no difference regardless of each nodes. Especially, percentage of fertility in "Yudal" was average of 80-82% as there was no difference regardless of cultural conditions but the late dense-sowing in "Miyuki" of 79% was very lower than autumna-transplanting of 87%.

The grain number per pod and grain yield per node were very highly possitive correlationship as Table 2.

4. Percentage of dependence for each nodes of grain yield per node:

The continuous curves of grain yield per node for each nodes is shown in Figure 8 as it would be nearly similar to the curves of ear length and pod number per ear. Accordingly, the grain yield per node and ear length or pod number per ear were very highly possitive correlationship as Table 2. That is, the grain yield of main stem in "Yudal" was more than it of primary branches of all.

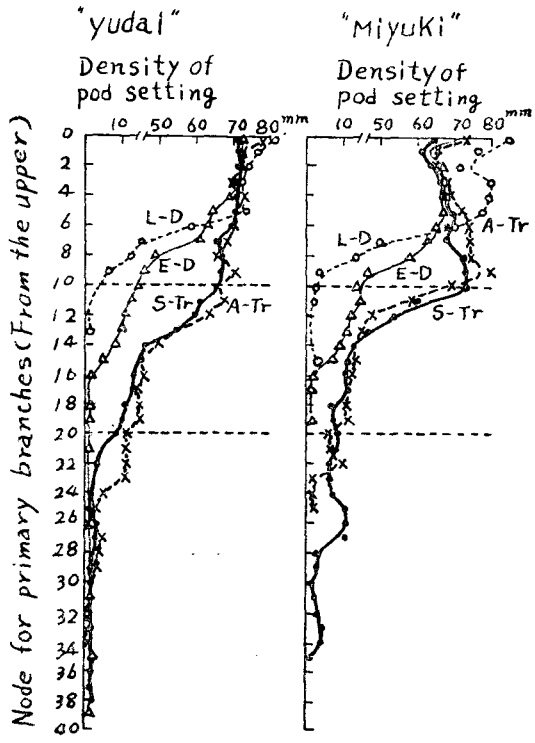

Fig. 7. Comparison to the density of pod setting for each nodes per plant (1971)

Regarding to it of primary branches the curve of transplanting was the apex at 9th node from upper that decreased very slowly from this to upper and decreased sharply to lower. The apex of curve in the early dense-sowing was at 4th node from upper, and it was decreased relatively slowly from this to lower. But it in the late dense-sowing was at 5th node and it was decreased sharply from this to lower. There was the decrease of grain yield per plant was caused by this. Also "Miyuki" would be be nearly similar to the tendencies of "Yudal"

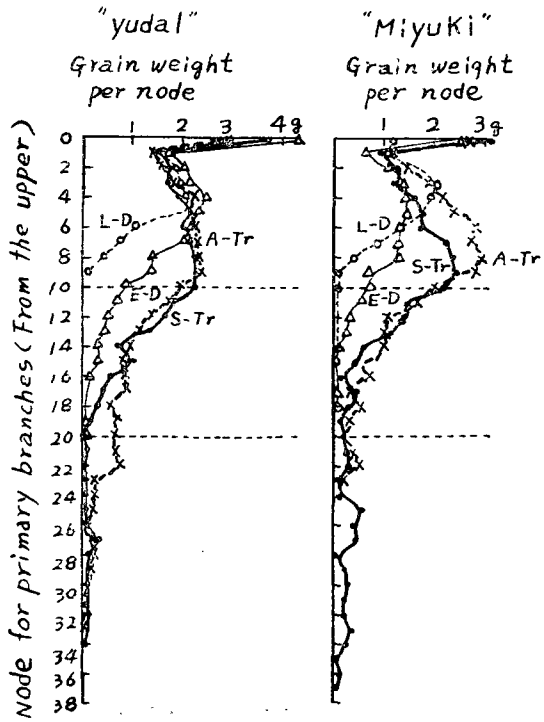

Fig. 8. Comparison to the gram yield per node for each nodes per plant (1971)

except autumnal-transplanting, but the grain yield of 8th node from upper wasm ore than it of main stem.

Cumulative percentage of dependence for each nodes in order from ear of main stem to ear of low branch with the grain yield per node is shown in Figure 9. Cumulative limit node reaching at 50% of the grain yield per plant in transplanting was 7-8th node from upper, in early dense-sowing 4-5th node, in late dense-sowing 3th node as two varieties were nearly identical tendencies. But it reaching at 90% in the autumnal-transplanting of "Yudal" was 19th node from upper, in the spring-transplanting 14th node, in the early dense-sowing 10th node, in the late dense-sowing 6th node. Comparatively, regarding to "Miyuki" that in the autumnal-transplanting was 15th node, in the spring-transplanting 24th in contrast with tendencie. of "Yudal". Relatively a lot of nodes was necessary to reach from the upper node to cumulative limit node because the developing of lower effective branhes was meagre as this nearly similar to its degreets The more dense-sowing the upper branches was, the more it becames remarkably that the degree of conis

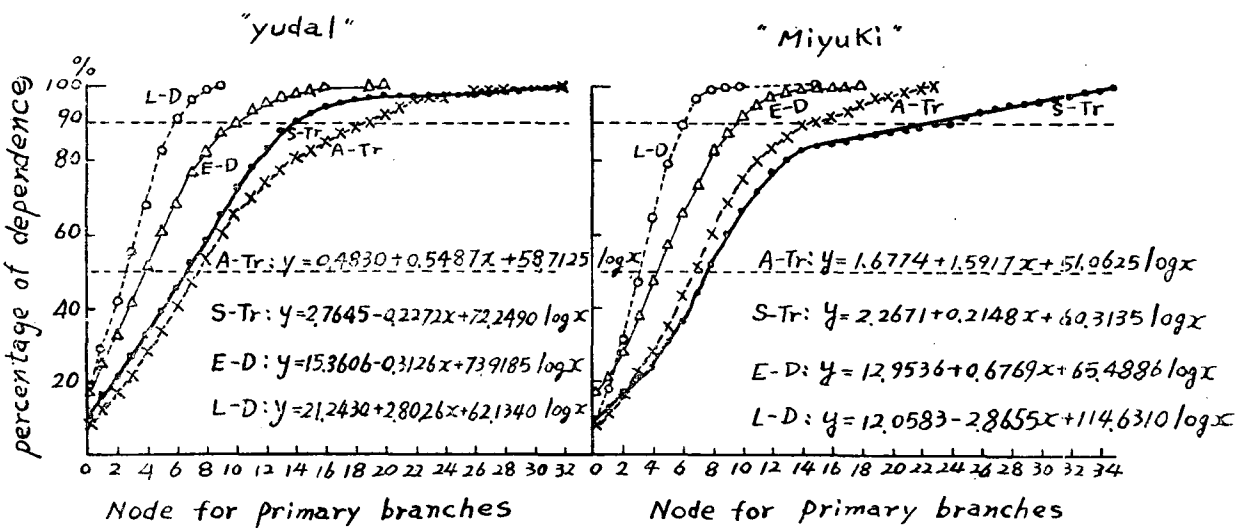

Fig. 9. Comparison to the percentage of dependence for grain yield per plant for each nodes (1971)

for total grain yield at upper branches was high.

5. Weight of 1,000 grains and Oil content of grain:

The tendencies for each nodes of weight of 1,000 grains is shown in Figure 10 as the weight of 1,000 grains in ear of main stem was heavier than in primary branches of all cultural conditions on both varieties. Regarding to the weight of 1,000 grains in primary branches the transplanting of "Yudal" was no difference regardless of each nodes but it of "Miyuki" was relatively lighter on the medium nodes. The lower branches in the direct-sowing was, the lighter it became on both varieties. Acc ordingly, average weight of 1,000 grains of direct-owing was relatively light. Especially, the early dense-sowing of "Miyuki" was lighter than the transplanting by about 0.6g. Therefore, among cultural conditions it could be shown significant difference.

Also the tendencies for each nodes of the percen tage of oil content in grain seeds is shown in Figurg 11 as it was no difference regardless of each nodes among cultural conditions in"Yadal". But the average percentage of oil content of direct-sowing in "Miyuki" was lower than that of transplanting by 1-2%. Especially, the most medium nodes of the early dense-sowing was low on it, but it was extermely high at the ear of main stem and upper 1st node. Therefore, there could be also shown significan difference among curtural conditions.

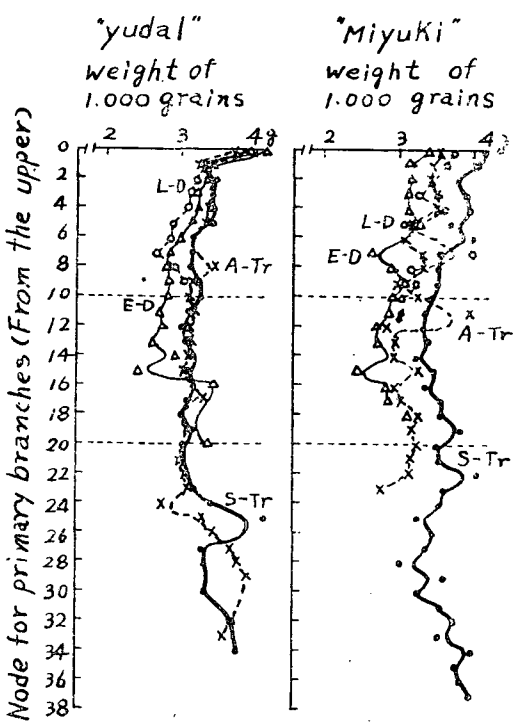

Fig. 10 Comparison to the weight of 1,000 grias Ps for each nodes per plant (1971)

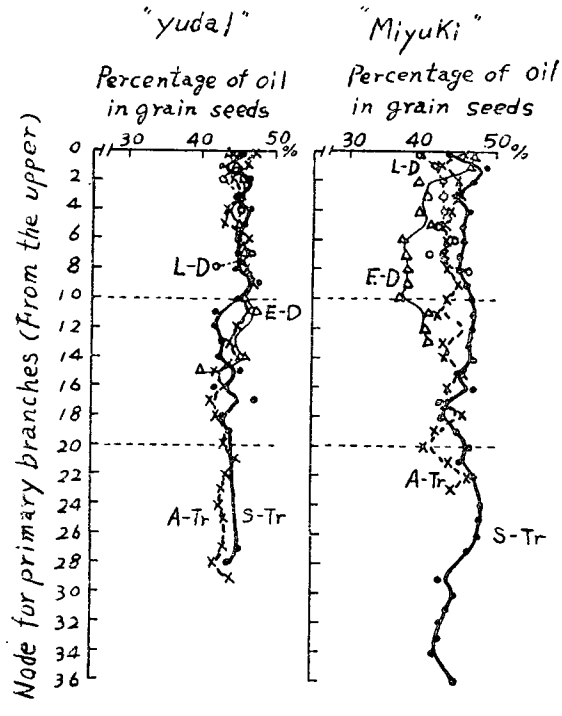

Fig. 11. Comparison to the oil content of grain seeds for each nodes per plant (1971)

DISCUSSION

1. Shoot-growing of the primary branches:

The plant diagram is convenient for us to observe the degree of developing for each primary branches, but the standing plant type is all observed with nearly umbrella-shaped because each primary branches of the standing plant was lengthened upward with an interior angle 20-30° to main stem. About the lant type Takezaki[9,10] reported the nearly gourd-shaped as the medium nodes that is 14-16 nodes from was short and from this nodes mas slowly lengthened and shortened again. Because that is difference with our cultual conditions and variety of rape.

We considered that the primary branch of early dense-sowing is profitable for secure of ear number per unit area where as it was shorter than of the autumnal-transplanting. Because the number of primary branch increased by 126% in "Yudal" and 174% in "Miyuki".

We will be necessary for the studing of method that would be able to effective branches of each cultural conditions.

2. Ear length and Pod number:

While "Miyuki" showed characteristic of variety that was developed stress on the upper branches, we think that characteristic for increase of pod number per plant was undesirable because the dossibility of developing in the lower branches was of very decrease or ineffective. Therefore, we fined that "Miyuki"was very hard characteristic for secure of ears on the lower branches.

Takezaki[9,10] reported that at Kyushu in Japan the developing of primary branches in transplanting, as a result of suppressing in the primary branches at the 14-16 nodes from upper, was shown the tendency of bi-model increase curve that the waits part of plant type was slimed in the middle. Because this is difference with our climatic and cultural conditions or variety of rape.

The tendency of the density of pod setting in "Yudal" was a significant apical growth,[4] but we think that the variation of fruiting phase per plant in "Miyuki" is large because the variation of it for each nodes was large according to cultural condtions.

3. Pod length and grain number per pod:

We think that the grain number per pod which have grossly influenced on grain yield according to variety, sowing time and density of planting is remarkable value.

Therefore, there is a basic subject for increase of garain yield; detecting the limited point for the secure of ears, that is, for the promotion of increase of effective primary branches per unit area to increase of pod number will have to devise by the best adaptable variety, sowing time and density of planting

4. Percentage of dependence for each nodes of grain yield per node;

Regarding as the grain yield of 8th node from upper was more than it of main stem in "Miyuki", we think that it was compounded both the characteristic of plant type and the vigorous developing of primary branches in the effect of transplanting. A investigation for eatimate of grain yield per plant will have to select the primary branch which wae high percentage of dependence for grain yield pes plant, because the degree of dependence for nodr number and main stem was singnificant difference as the variety and cultural conditions.

We could acknowledged that all yield component was shown a severe componsationess with one another for yielding to all grain yield of the plant from developing of primary branches to grain number per pod.

Regarding to the grain yield per plant the early denese-sowing of 25g in "Yudal" was very lighter by 10g than autumnal-transplanting, but it would be calculated for epochal increasing of grain yield per unit area rather than this. Howver, we will have to attempt the trials to find adaptable limit point, this is the reason why it was concerned by lodging and a missing plant.

5. Weight of 1,000 grains and Oil content of grain seeds:

The average of grain puality in the early dense-sowing was some unattainable and the tendencies of grain quality for each nodes in it was also unequal. Therefore, the influence which reached total grain quality was concerned, but the degree of consist for total grain yield at lower branches was so long that this could be no great anxiety.

LITERATURE CITED

1. Crop Exp. Sta. 1969. Annual Report. (Vol. Industrial Crop): 661-680
2. ——. 1971. ——: 12-24, 211-231.
3. G. A. Niles. 1969. Growth and Fruiting Modifications for Mechanized production. Beldtwide Cotton Production Research. Conferences. January 7-8:114-117.
4. Hama, T. 1952. Plant Morphology. Co. Korona: 76
5. Kae, B. M. and J. I. Lee. 1969. A New Introduced Rape Variety "Miyuki" The Research Reports of the O. R. D. Vol. 12. No. 1:93-95.
6. ——. and K. Y. Chung. 1970 Studies on the Flowering Habit of Rape Under the Different Cultural Conditions. ——. Vol. 13(Crop):62-72.
7. ——. J. I. Lee and B. S. Kwon. 1971. A New Rape Variety "Yudal". Vol. 14(Crop):67-70.
8. Nagada, T. 1956. Outline of Agricultural Science, Dept. Crop, Vol. Soybean:42-43.
9. Takezaki, T. and T. Iura. 1966. Studies on the Growing Phase of Rape Under the Direct Sowing Condition. III. Comparison. to Rape Varities on the Fruiting Phase Under the Transplanting and Dense-sowing Conditions. Proceedings of the Crop Science Society of Japan, Kyushu Branch 26:9-12.
0. ——. ——. ——. ——. Ⅳ. For the Fruiting Phase of Rape Varieties Under the Transplanting and Direct Sowing Conditions. ——. 13-19