ORIGINAL ARTICLE

MEASURING WORKING HOURS INPUT IN VINE GROWING AT WORK ORGANIZATION BASED ON PHENOLOGICAL PHASES
MUNKAIDŐSZÜKSÉGLET MÉRÉSE A SZŐLŐTERMELÉSBEN FENOLÓGIAI FÁZISOKRA ALAPOZOTT MUNKASZERVEZÉS MELLETT

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ABSTRACT

Research was based on phenological phases of Italian Riesling, involving differences in labour and financial input for dry, optimal and wet weather. Worktime demand for certain operations in vine growing was determined with an analytic method, work day survey and We worked out alternatives for dry, optimum and wet weather on the basis of phenological phaseses.

The worktime demand for the phenological phases with all their operations were analysed and planned in an itemized way based on our findings. We used them to work out the worktime demand for the given vine land for each operation.

To analyse differences coming from diverse methods of cultivation and spacing, the material, operational and total costs of hand and mechanized labour were projected for 1 hectare and variance analysis was made.

KEY WORDS: vine growing, phenological phases, worktime demand, operation, times, cultivation

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DETAILED ABSTRACT

Tanulmányoztuk az alkalmazott borszőlő-termelési módok munkaerő szükségletét az Olasz Rizling példáján. A kutatást a fenológiai fázisokra alapoztuk, különböző kezelési módok mellett. Az egyes munkafeladatok időszükségletét különböző módszerekkel határoztuk meg:

- A metszés esetében analitikus módszerrel.
- A fitotechnikai műveletek esetében munkanap felvételezéssel.
- Gépesített munkák esetében a Felleg-féle ciklusmódszert alkalmaztuk.

Tekintettel az időjárási eltérésekre 3 alternatívát dolgoztunk ki:

1. Száraz időjárásra, ami korai tavaszt jelent, kevés csapadékot, meleg nyarat és alacsony relatív páratartalmat.
2. Optimális időjárásban, ami normális tavaszt, kedvező agrometeorológiai feltételeket és a csapadék mennyiség kedvező eloszlását.
3. Nedves időjárásra, amikor a tavasz később érkezik, sok csapadékkal az egész vegetációs periódusban, meleg nyarat és magas relatív páratartalmat.
4. Az Olaszrizling esetében 7 fenológiai fázissal számoltunk.

Tekintetbe véve a sokéves tapasztalatot, a fenológiai fázisok következő intervallumait határoztuk meg:

- Téli periódus, a levél hullástól április 10-ig.
- Rügyfakadástól az ötleveles fázisig - április 11- május 9-ig.
- A vessző fejlődés kezdetétől a virágzásig - május 10-24-ig.
- Virágzás - május 25- június 4-ig.
- Terméskötéstől a fürtzárásig - június 5- június 30-ig.
- Fürtzáródás és növekedés a zsendülésig - június 1- augusztus 25-ig.
- Zsendülés, érés - augusztus 26- október 10-ig.

A megadott átlagos paraméterektől lényeges eltérések lehetnek, ámbár, ha a tavasz korábban kezdődik, minden fenológiai fázis abban az irányban tér el.

A munkaidőszükséglet elemeztük műveletenként mind a hét fenológiai fázisban és részletesen terveztük normatív értékek alapján, amelyek kutatásaink eredményei képezik.

Ezeket az eredményeket felhasználtuk a szőlő területek munkaidőszükségletének kimutatására műveletenként. Kidolgoztuk a kézimunkaerő mellett a gépimunkaerő szükségletet is az egyes függönyre és sylvozra.

Az adatok jól szemléltetik a művelési módból és tőkeszámból adódó különbségeket. A két szélső érték közötti eltérés 45,3% tesz ki. Ami lényegesen kihat a költségekre, eredményre és a munkaerő hatékonyságára.

Művelésmódból, a térállásból és a tőkeszámból adódó eltérések elemzésére a kézi, a gépi munkaerő szükséglet, anyagi, műveleti és összes költséget vetítettük 1 ha-ra és elvégeztük a variancia analizist.

INTRODUCTION

Vine is one of the plants demanding high labour input. If we study the history of vine growing, it becomes obvious that developing its production method has always been aimed at increasing quantity and quality and decreasing the amount of manual labour input, that is, raising productivity and profit.

We wanted to study the labour input of the applied production system and cultivation method in the case of Italian Riesling, the most popular vine variety in the Nivegy Valley belonging to the Balatonfüred-Csopak wine-district. The study was based on phenological phases involving differences in labour and financial input for dry, optimal and wet weather.

Work time demand in vine growing as a research topic

Work time demand for vine growing greatly differs from the similar parameters of some other plants. During growing, several operations have to be performed by hand. The work time demand for various crops is different:

winter wheat	12,5-18 working hours /ha/year
maize	11-16 working hours /ha/year
vine	565-805 working hours /ha/year

(The working hours for field crops were calculated by data given by KITE technology – Maize and Industrial Plant Growing Cooperations Share Company – while as for vine, we used our own measurings). According to these data, live labour demand in vine growing constitutes an item whose study – by using work organizational methods – is still topical and it might yield improving results. This is in harmony with what Csepregi (1982) stated:

Work organizational activities in field crops aim at increasing the efficiency of live labour, which ultimately is a measurable result of development. This is besides professional priorities why we study — the live labour demand of the given crop and the number of days and hours the given operation will take, considering ecological factors.

The high hand labour input raised problems in earlier times as well. Calculating according to the norms laid down by the Ministry of State Farms in 1955, which shows the level of mechanization as well, the following amounts of working hours were needed to cultivate one hectare of vineland:

in hilly areas:	3833 working hours
in slope areas:	3264 working hours
in sandy areas:	2821 working hours

Accordingly, vine growing needed a lot of hand labour in earlier times as well.Change in technology ocurred rather slowly. In 1960, the ratio of vineyards cultivated with machines constituted only 1% of the total area, and cultivation performed by animal power was estimated only 5-6%.Development after this, however, speeded up considerably. In the 1970 s, in farms located in the highlands of Balaton, the use of working hours was about 700 hours as a result of technological change.Based on our research of several years we found different values. Differences emerged between worktime demand and utilization, which was the result of differences between normative values and actual worktime input.

Methods applied

Worktime demand for the various operations in vine growing was determined with different methods:

- using analytic method in pruning
- working day surveying in phytotechnical operations
- using the Felleg-type operational cycle-time method for working operations by machinery.

When cycle time method was used, we determined turn around as follows:

$$M = \frac{10000 \cdot X_3}{X_4 \cdot X_5 \cdot K}$$

M = number of one way turns
X_3= capacity of container
X_4= working width
X_5= length of plot
K = the dose applied or average yield

Knowing the number of one vay turns and/or having corrected it, cycle time was calculated in the following way:

$$I = M \cdot \left(i_2 + \frac{0{,}06 \cdot X_5}{V} \right) + j$$

I = cycle time
i_2 = time of turn at the end of the plot
v = speed of work
j = time for filling or emptying

Cycle time or base-time, calculated this way, complemented with the other elements of useful time and in this way we got time value, which did not contain time losses.

Operations performed by machines belong to several types. As for tilling, it is defined as a main operation, while some other operations involving the application of chemicals, fertilizers etc. belong to the main, sub or basic types of operations. During calculating a procedure adequate for the plant should be used (FELLEG 1973).

In the case of main and sub-type operations, output is higher, consequently working hour requirement is lower with this kind of working method than with the main type, since both operations (main and sub-type) are done with the same machine, so areal output is lower, while working hour requirement is higher.

Working hour requirement calculated with analytic and Felleg's method of operational cyclic time was checked by surveying working days in the model farm on several occasions.

Work organization based on phenological phases

While planning real processes, we worked out three alternatives because of the diversity of weather factors. They might help organize working processes and operations: It is necessary because agrometeorological factors determine not only agrotechnical requirements but also affect starting and finishing times of agrotechnical periods. The three basic ways, models are as follows:

1. For dry weather, which involves early spring, little and uneven precipitation, hot summer, low relative humidity (atmospheric drought).
2. For optimum weather, with optimal spring, favourable agrometeorological conditions, evenly distributed and adequate amounts of precipitation.
3. For wet weather with spring arriving later than normal, too much precipitation during growing season, cool summer and high relative humidity.

The operations to be performed in vine lands were planned on the basis of phenological phaseses in all models, in harmony with the method of cultivation, spacing and parameters required in the given technique.

Phenological phases

There are seven phenological phases in wine grape growing in the case of Italian, Riesling – the most popular variety in the region. Taking the long experience into account, phenological phases can be determined with the following intervals:

Dormancy	from leaf fall to 10 the April
From bursting of buds to the 5 leaf stage	between April 11 & May 9
From growth of shoots to blossom time	between May 10 & May 24
Flowering	between May 25 & June 4
From setting to the closing of cluster	between June 5 & 30.Closing of cluster
Growing till sprouting	between July 1 & August 25
Sprouting, ripening	between August 26 & Oct. 10

There might be considerable divergences from the above average parameters, although when growing season begins earhier, all the phenological phases move in that direction.

From the point of view of work organization, the necessary operations in the given phenological phase have to be performed in their optimal sequence, we have to keep waiting times, consider their capacity demand, agrometeorological conditions, the number of performable working hours and choosing the suitable period for the operation.

Characteristics of operations in certain phenological phases

The first phenological phase with vine is dormancy, which actually is the longest of all. It begins after the vine shoots are ready and leaves have fallen, and it lasts up to the bursting of buds. During this period, five operations have to be performed – their sequence is to be determined on a professional, logical basis.

Pruning is one of the most important operations. There is a long period of time to do it. The optimum time, however, is early, spring, when the weather is better and longer shifts can be organized. Damages of winter frost can also be corrected. Bud loading – that is the number of buds left – should be shaped according to the parameters of the vine land, considering professional and market situations. In general, during pruning, the necessity of individual care is expressed to a great extent.

The operation of pruning is split up into operation elements, allocating a certain amount of time to each element – this is how we established the normative working hour demand for each vine stock. Difficulties in measuring was caused by the fact that elements of operation are converging, and are hardly separable.

Elements of operation within pruning are as follows: surveying, clearing, forming the number of buds, removing the shoots that we cut, inspecting bud loding. From the description of the above operation elements it becomes obvious how complicated the task is. In spite of this, we had to find normative time and calculate working hours demand for one unit area for both cultivation methods as well as spacing.

Following pruning we have to **get rid of the cuttings**, the method to be used here can be cutting up or collecting and carrying them off. As we found, both of them demand a similar amount of time.

Reparing the trellis system in a frost-free period after pruming is easier and more simple, but it has to be done before the binding operation. Its normative time demand is difficult to calculate, it can rather be determined in an empiric way.

Binding the stem and the shoots has to be performed after pruning but before buds are bursting. Its worktime demand is similar when normative time value is used for calculation.

Nutrient supply – two main types – manuring and fertilization. Manuring is a task that has to be repeated every 3-4 years, while fertilization is to be performed annually.

The second phenological phase falls between bursting of buds and the 5 leaf stage, during which the first tillage and plant protection operations have to be done.

The first spraying can come before cultivation within the row and hoeing but in this case, waiting time has to be considered because of health regulations. Surface cultivating in rows combined with land clearing is done with a reinforced mechanical hoe provided with a side breaker plough.

The hoe goes in the rows twice. A power machine of 38 KWh output or bigger is needed, eg. a four – wheel drive tractor. The other tillage operation, mechnical hoeing has to be done from two sides after land clearing as soon as possible to prevent the soil from drying.

The third phenological phase lasts from shoot growth, the 5 leaf stage, to flowering. During this about 2 weeks' period, shoot selection and binding have to be performed, furthermore the second spraying has to be done and the 3rd surface tillage is also due.

Stem clearing, shoot selection – as an operation it can be done in two steps or in one. If we do it separately, the total working hours requirement may increase as a result of more locomotion.

The second spraying is done prior to flowering between 20-25 May with systemic chemicals of longer residual action.

The third surface tillage is needed to kill weeds and it can be done with discs and a ring float or with a cultivator and a smoolher.

The fourth phenological phase is very important from the point of view of yield formation. This is the period of time which takes 6-8 days with certain varieties under optimal weather conditions, so, if possible, no operation should be planned. Should flowering take longer – as the lesser evil – spraying must not be delayed.

The fifth phenological phase involves the period from fruit setting to the closing of cluster and is usually accompanied with intensive shoot growth. It is typical that these 25 days, 2 sprayings – and out of the two phytotechnical operations – 2 shoot selection

-, stem clearing and binding in the shoots have to be performed.

The third spraying has an outstanding importance from the point of view of yield. The occurrence of early grape mildew and botrytis falls on this period, furthermore the first generation of grape berry moth is also likely to appear.

As a result of intensive shoot growth, shoot selection and binding are due to be done parallel with stem clearing.

The fourth spraying is to be performed at the end of June till the closing of cluster the. Working time demand for this spraying is the same as for earlier ones, but the dose is at its highest, consequently it requires a longer time, just like water transportation and filling.

The 6th phenological phase lasts for about 45 days, from the **closing of clusters** to sprouting. With the Italian Riesling variety, it takes up the whole of July and the beginning of August.

The 5th spraying concentrates on protection against peronospora and powdery mildew.

Pinching off falls on the 2nd decade of July. Intensive shoot growth is over by now, and the vine plant is made to develop the clusters more intensively. Pinching off is followed by the 6th spraying with contact chemicals. The best time to do it is directly after pinching the vine off because it helps the unprotected surface on vine shoot ends to heal up.

Around this time, following pinching off, the 3rd cultivation within the rows has to be done to kill the weeds.

The seventh phenological phase covers the period between sprouting and ripening. All the plant protection operations are now finished, the phytotechnical operations also. At the and of the 4th cultivation within the rows hoeing should be done in reparation for harvesting.

Table 1. Changing working hours requirement with different spacing and methods of cultivation for Italian Reisling Variety under optimal weather conditions in the Balaton Highlands

Operation	Single Curtain 3,5x1,20 2380 vine-stocks/ha		High Cordon 3,5x1,2 2380 vine-stocks/ha		Single Curtain 2,9x0,9 3830 vine-stocks/ha		High Cordon 2,9x0,9 3830 vine-stocks/ha	
	hour	%	hour	%	hour	%	hour	%
Pruning	99	17,6	64	10,3	137	19,1	96	11,9
Removing cut-off	1	0,2	1	0,2	1	0,1	1	0,1
Repairing supporting system	13	2,3	25	4,0	18	2,5	31	3,9
Binding stem	40	7,1	50	8,0	64	8,9	80	9,9
Clearing stem and Shoot selection	35	6,2	85	13,7	58	8,1	127	15,8
Binding shoot	-	-	46	7,4	-	-	75	9,3
Combing	45	8,0	-	-	71	9,9	-	-
Pinching off	22	3,9	22	3,5	32	4,5	32	4,0
Cutting off tillering	-	-	19	3,1	-	-	25	3,1
Hoeing	8	1,5	8	1,3	10	1,4	10	1,2
Spraying	9	1,6	9	1,4	11	1,5	11	1,4
Guarding the	40	7,1	40	6,4	64	8,9	64	8,0
vinegard	21	3,7	21	3,4	21	2,9	21	2,6
Picking grapes by hand	200	35,1	200	32,2	200	27,8	200	24,8
Machines used	10	1,8	10	1,6	10	1,4	10	1,2
Carrying empty and full containers	20	3,5	20	3,2	20	2,8	20	2,5
Nutrient supply	2	0,4	2	0,3	2	0,3	2	0,3
Total	565	100	622	100	719	100	805	100

Source: own data

The tool for the 4th cultivation within the rows is the reinforced mechanical hoe combined with a side breaker plough.

Vintage (harvest) is the operation during the ripening period. Its time should be determined considering viticultural needs. It takes place at different times depending on variety, which should also be considered when choosing vine varieties. Working hour demand for Italian Riesling is 200 h/ha (0,5 t/10 hour' working day). The other related operations (empty and full trays and butts) demand 20 h/ha, and using machines take up 10 h/ha.

The last operation in the calendar year is the 5th cultivation within the rows, which – in classical terminology is called ploughing in. Burying is done with a plough or a medium depth cultivator and a plough share fixed on one side. This operation should be done in the dormancy period, at the end of the calendar year.

We found considerable differences concerning the costs of certain operations and with most of them there was no material cost indicated. The two most important items are the use of fertilizer and vintage. Fertilization involves material and operational costs, while vintage includes only operational costs, which is higher than all the others.

To analyse differences coming from diverse methods of cultivation and spacing, the material, operational and total costs of hand and mechanized labour were projected for 1 hectare and variance analysis was made (table 2).

CONCULSIONS

- The single curtain method of cultivation at both spacings requires less worktime than high cordon.
- The high time demand of phytotechnical operations, their limited time-interval all indicates that single curtain cultivation at similar spacing requires by 10% less worktime than high cordon.
- The worktime requirement of pruning is increased by the rising number of vine – stocks deriving from changes in spacing, consequently pruning vine in single curtain cultivation takes higher worktime values than in high cordon.
- Studying operations in the dormancy period (pruning, reparing the support system, binding) it can be stated that single curtain cultivation demands more time expressed both in working

Table 2.: Comparision of worktime and material demand of vine growing, using variance analysis with different weather valuations (values for 1ha, excluding the effect of field side)

Parameters	Worktime requirement (hour)						Its costs(eFt)									
	By hand			By machine			material			cultivation			Total		
Variation	average	%*	deviation^T	average	%*	deviation^T	average	%*	deviation^T	average	%*	deviation^T	average	%*	deviation^T
1.	691	95,1	206	71,0	95,6	21,7	107,4	93,9	52,5	263,1	96,5	69,4	370,4	94,7	103,4
2.	726	100,0	207	74,1	100,0	22,2	114,3	100,0	53,5	272,7	100,0	68,8	391,1	100,0	106,3
3.	759	104,5	217	79,4	107,2	22,1	118,5	103,7	53,6	294,5	108,0	74,0	412,853	105,6	110,9
$SzD_{5\%}$	21,7	3,0	-	1,8	2,5	-	2,2	1,9	-	9,6	3,5	-	9,2	2,3	-
$F_{(2,10)}$	24,5		-	55,9		-	64,3		-	28,3		-	53,1		-
Szignif.	p<0,1%		-	p<0,1%		-	p<0,1%		-	p<0,1%		-	p<0,1%		-

Note: deviation^T = average difference (deviation) among the 6 plots involved in the study
$F_{(2,10)}$ = F value as calculated at 2 and 10 freedom value in the variance analysis comparing the variations
* = in the percentage of the 2 nd version

hours and percentage as a result of pruning demanding much more time, although in this period, the necessary operations can be performed well.

- Vintage represents the top of working activities, which quarantees the quality of the end product when performed in time and well. The time requirement of vintage is more reactive to the quality of phytotechnical operations and to average yields. The greater size of cluster, the simplicity of vintage, the method of picking grapes and the skilfulness of people in doing it might also cause greater differences.
- Changing spacing and methods of cultivation aims at increasing quality and stability of yield, but unfortunately, the drop in the quality of the end product falling on one working hour and the productivity of labour is also detectable. According to our studies – with different methods of cultivation and spacing – at a yield of 100 kilograms, the following values are received: 17.7, 16.1, 13.9, 12.4 kg/hour.
- It must be emphasized that the accuracy of the measuring methods is rather limited. We should find more up-to-date and more reliable methods. The results we obtained and the potentials of quality improvement, however, prove the applicability of this method at present.

REFERENCES

[1] Csepregi P.: Pruming Vine and Phytotechnical Operations in Vine. Agricultural,Publishing House, Budapest, 1982.

[2] Dietrichstein H.: One – wire supporting system, the Metternich system, Vine and Viticulture Informatory, 11 th volume No. 3.

[3] Felleg J.: Determining labour output ratio in Crop growing, Agricultural,Publishing House, Budapest, 1979.

[4] Klenczer, Mrs.: Mechanical technology of vine cultivation, Agricultural, Publishing House, Budapest, 1981.

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