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A Simple Fortran Program for Efficient Forest Nursery Management[1]

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컴퓨터 프로그램을 利用한 林業苗圃의 效率的 管理[1]

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ABSTRACT

The use of computers for storing or analyzing the data collected is expected to increase in next decade. A simple program written in Fortran IV was used at the Seoul National University nursery for inventorying the trees growing and for recording the past cultural treatments and present status. The data in the program included blocks, uses, tree species, damage conditions and cultural treatments, and each of the items were branched into specific classes. Thus the record printed in the output helped identify quickly the damage conditions of each block which, in turn, contributed to manage efficiently forest nursery.

Key words: forest nursery management; Fortran program.

要 約

資料를 分析하고 保管하는데 컴퓨터를 利用하는 趨勢가 점차 증가하고 있다. 서울大學校 苗圃場에서는 苗木을 調査點檢하고 過去의 栽培法과 現在의 苗木의 狀態를 記錄하는데 컴퓨터 프로그램을 利用하였다. 區劃의 用途, 樹種, 被害狀態, 栽培法 等에 關한 모든 資料를 여러 階級으로 分類한 후, 本 프로그램으로 處理하였다. 여기에서 나온 結果를 보고 各 區劃의 被害狀態를 신속히 確認할 수 있었고 이리하여 苗圃를 效率的으로 管理할 수 있을 것이다.

INTRODUCTION

Forest nursery is the basis for growing trees to be used in various purposes: gardening, aesthetics, recreational use, wood and wood products in the future. One of the important steps in successful nursery management is proper inventory of seedlings and record of past treatments. Especially, occasional inventories must be made of the amount of planting stock in various stages of growth because seedlings may be often lost due to damage by insect pests or climatic injury.

Trees in nurseries require protection against pests, wind, excessive heat, drought, freezing, frost heaving, drowning and water erosion. Protection of nursery stock demands constant vigilance, quick action, and accurate knowledge of the pests. The early discovery of injury is quite as important as prompt treatment. However, inventory tends to be a tedious task (Stoeckeler and Jones, 1957).

Some computer programs were tried on the

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classification of forest land (Heller, 1981), remote sensing application for forest planning (Nakajima and Oknuki, 1981) or retrieval system for forest herbarium (Taoda *et al.*, 1981) but little on forest nursery management. Computer-aided, quick identification of the number of trees in the nursery by kinds, classes or damages will help manage effectively nursery operations.

Accordingly, the objective of this study was to introduce a simple Fortran program for inventorying the trees growing and for recording past cultural treatments or present status at a nursery.

MATERIALS AND DATA SYSTEM

The seedlings and trees growing at the Seoul National University nursery were provided as source of data. The nursery located on Suweon campus has been used mainly in Silviculture Laboratory purposes for students. The operating areas reached 1.3 ha and tree age class ranged from 1-0 to 1-9.

Nursery information was organized with the following basic data.

Step 1. Input Data

1. Basic Information
   1) Block number
   2) Uses for : Research, Sale, Student's Laboratory, Greenhouse, Office, Others
   3) No. of species composed
   4) No. of damage types occurred
2. Tree Identification
   1) Scientific name
   2) Age
   3) Height (m)
   4) Basal diameter (cm)
   5) Reproduction method
3. Cultural Treatments
   1) Fertilization
   2) Irrigation
   3) Weeding
   4) Fumigation
   5) Shading
   6) Mulching
   7) Past treatment of pesticides
4. Damage Condition (Cause of damage; Damaged portion; Rate of damage)
   1) Cause of damage : Disease, Insect, Drought, Flooding, Heat, Coldness, Snow, Toxicity, Physiological change, Others
   2) Damaged portion: Leaf, Stem including branches, Root, Whole tree
   3) Rate of damage
      (1) Low : Symptom is visible due to damage
      (2) Moderate: Care is required
      (3) High: Proper treatment is needed
      (4) Worst: Discard is allowed

Step 2. Output Record

The following record will be printed in the output.

NURSERY RECORD

BLOCK NO.	USES(1)	NO. OF SPECIES COMPOSED	NO. OF DAMAGE TYPES OCCURRED
001	1	1	2

SCIENTIFIC NAME
Firmiana platanifolia

TREE IDENTIFICATION					CULTURAL TREATMENTS(4)						
AGE	HT	BD(2)	NO. OF TREES	RE(3)	FER	IRR	WEE	FUM	SHA	MUL	PES
8	10.5	9.8	30	3	0	0	1	0	0	0	0

CONDITION OF DAMAGE
212, 122

USES(1) : USES FOR

RESEARCH : 1	SALE : 2	ST. LAB : 3
GREENHOUSE : 4	OFFICE : 5	OTHERS : 6

BD(2) : BASAL DIAMETER

RE(3) : REPRODUCTION METHOD

SEEDING : 1	CUTTING : 2	GRAFTING : 3
LAYERING : 4	TRANSPLANTING : 5	SPROUTING : 6

CULTURAL TREATMENTS(4)

IF IT HAS BEEN DONE, WRITE THE FREQUENCY OF TREATMENTS
OTHERWISE, WRITE 0

(SORT OF TREATMENT)

FER : FERTILIZATION	IRR : IRRIGATION	WEE : WEEDING
FUM : FUMIGATION	SHA : SHADING	MUL : MULCHING

PES : PAST TREATMENT OF PESTICIDES

DAMAGE CONDITION

(CAUSE OF DAMAGE)

DISEASE : 1	INSECT : 2	DROUGHT : 3	FLOODING : 4
HEAT : 5	COLDNESS : 6	SNOW : 7	TOXICITY : 8
PHYSIO : 9	OTHERS : 10		

(DAMAGED PORTION)

LEAF : 1	STEM : 2	ROOT : 3	WHOLE : 4

(RATE OF DAMAGE)

LOW : 1	MODE. : 2	HIGH : 3	WORST : 4

EXAMPLE
212 MEANS THAT TREATMENT IS REQUIRED TO LEAF DAMAGED BY INSECTS.

PROCEDURE

One can investigate the conditions of the trees growing in the nursery as needed, and record them as numbers in a coding sheet except for scientific name. For an example, inputting data recorded from a block are illustrated as follows:

001, 1, 1, 2
FIRMIANA PLATANIFOLIA
8, 10.5, 9.8, 30, 3, 0, 0, 1, 0, 0, 0, 0
2, 1, 2, 1, 2, 2

The program written in Fortran IV can be easily used at the Computer System HP 3000. No more than 2 KB in memory capacity are needed to perform this program per each time.

CONCLUSION

Steady increasing use of computers for inventory and record of forestry data is expected in the next decade. Therefore, such a quick, simple program understandable to forester is needed for efficient management, especially, at a nursery. This program helps identify easily the damage by various types or causes as well as provide the necessary treatment for each damage before trouble starts. It may take less than 2-hour to get proper information from recording items and treatment in the field.

LITERATURE CITED

1. Heller, R.C. 1981. Forest stand and site variables prove useful for improving computer-aided classification of forest land and for rating risk from insect damage. Pages 225-235 *in* 17th IUFRO World Congress, Div. 6, Kyoto, Japan.
2. Nakajima, I. and I. Ohnuki. 1981. Computer-aided remote sensing application for forest planning. Pages 195-210 *in* 17th IUFRO World Congress, Div. 6, Kyoto, Japan.
3. Stoeckeler, J. H and G.W. Jones, 1957. Forest Nursery Practice in the Lake States. USDA Forest Service Agriculture Handbook No. 110, 124 PP.
4. Taoda, H., Y. Kobayashi and T. Ohkawara. 1981. A card retrieval system for forest herbarium. Page 498 *in* 17th IUFRO World Congress, Div. 6, Kyoto, Japan.

APPENDIX A. FORTRAN SOURCE PROGRAM LIST

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PAGE 0001   HP32102B.01.01  FORTRAN/3000  (C) HEWLETT-PACKARD CO. 1978  TUE, NOV 29, 1983, 10:40 AM

      IMPLICIT INTEGER(A-Z)
      REAL HT,BD
      CHARACTER*13 C(7),B(6),A*10(6),D*8(10),E*5(4),F*9(4),SP*35,REPO*18
      DIMENSION CD(9),NCD(7),TR(7)
      DATA A/'RESEARCH','SALE','ST.LAB','GREENHOUSE','OFFICE',
     -       'OTHERS'/
      DATA B/'SEEDING','CUTTING','GRAFTING','LAYERING','TRANSPLANTING',
     -       'SPROUTING'/
      DATA C/'FERTILIZATION','IRRIGATION','WEEDING','FUMIGATION',
     -       'SHADING','MULCHING','PESTICIDE'/
      DATA D/'DISEASE','INSECT','DROUGHT','FLOOD','HEAT','COLDNESS',
     -       'SNOW','TOXICITY','PHYSIO','OTHERS'/
      DATA E/'LEAF','STEM','ROOT','WHOLE'/
      DATA F/'! LOW !','! MODE. !','! HIGH !','! WORST !'/
C
      CALL OUTLINE(A,D,E,F)
C
      REWIND 5
   33 READ(5,*,END=100) BL,US,MULT,(NCD(IG),IG=1,7)
      WRITE(6,333)
  333 FORMAT(1H1,10X,'<<< BLOCK INFORMATION >>>',3(/))
      DO 10 I=1,6
      IF(US.EQ.I) WRITE(6,101)BL,A(I)
   10 CONTINUE
C
      IF(US.GE.4) GO TO 33
C
      DO 15 I=1,MULT
C
      READ(5,102) SP
  102 FORMAT(A35)
      WRITE(6,103)SP
  103 FORMAT(2(/),1X,'SPECIES : ',A35)
C
      READ(5,*) AG,HT,BD,NT,PE,(TR(K),K=1,7)
      WRITE(6,104)AG,HT,BD,NT
  104 FORMAT(/1X,'AGE:',I2,'   HEIGHT:',F5.2,   ,'   BASAL DIAMETER:'
     -       ,F5.2,'CM      ',I4,' TREES.')
C
      DO 20 J=1,6
      IF(PE.EQ.J) WRITE(6,105)B(J)
   20 CONTINUE
      WRITE(6,206)
  206 FORMAT(2(/),1X,'< CULTURAL TREATMENTS >')
C
      DO 25 J=1,7
      WRITE(6,106) C(J),TR(J)
   25 CONTINUE
C
      IF(NCD(I).EQ.0) GO TO 15
      N=NCD(I)*3
      READ(5,*) (CD(J),J=1,N)
      WRITE(6,207)
  207 FORMAT(2(/),1X,'< DAMAGE CONDITION >')
C
      DO 30 R=1,N,3
      DO 35 J=1,10


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      IF(CD(R).EQ.J)WRITE(6,107)D(J)
   35 CONTINUE
      K=1+R
      DO 40 L=1,4
      IF(CD(K).EQ.L)WRITE(6,108)E(L)
   40 CONTINUE
      M=2+R
      DO 45 ML=1,4
      IF(CD(M).EQ.ML)WRITE(6,109)F(ML)
   45 CONTINUE
   30 CONTINUE
   15 CONTINUE
      GO TO 33
C
  100 READ(7,111) YR,NO,DA,REPO
  111 FORMAT(I4,2I2,A18)
      WRITE(6,112)YR,NO,DA,REPO
```

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  112 FORMAT(3/20X,'$ REPORT DATE : ',I4,'.',I2,'.',I2,2/
     *20X,'$ REPORTER : ',A18)
C
      WRITE(6,19)PROCTIME(0)/1000.
   19 FORMAT(4/5X,'****** CPU TIME =',F6.2,' SECONDS ******')
  101 FORMAT(1X,'BLOCK NO. : ',I3,' ; ','FOP ',A10)
  105 FORMAT(/1X,'REPRODUCTION METHOD : ',A13)
  106 FORMAT(/1X,3X,A13//8X,I1)
  107 FORMAT(/3X,A8)
  108 FORMAT(5X,A5,';')
  109 FORMAT(1H+,11X,A9)
      STOP
      END
```

PROGRAM UNIT MAIN' COMPILED

PAGE 0003 HEWLETT-PACKARD 32102B.01.01 FORTRAN/3000 TUE, NOV 29, 1983, 10:40 AM

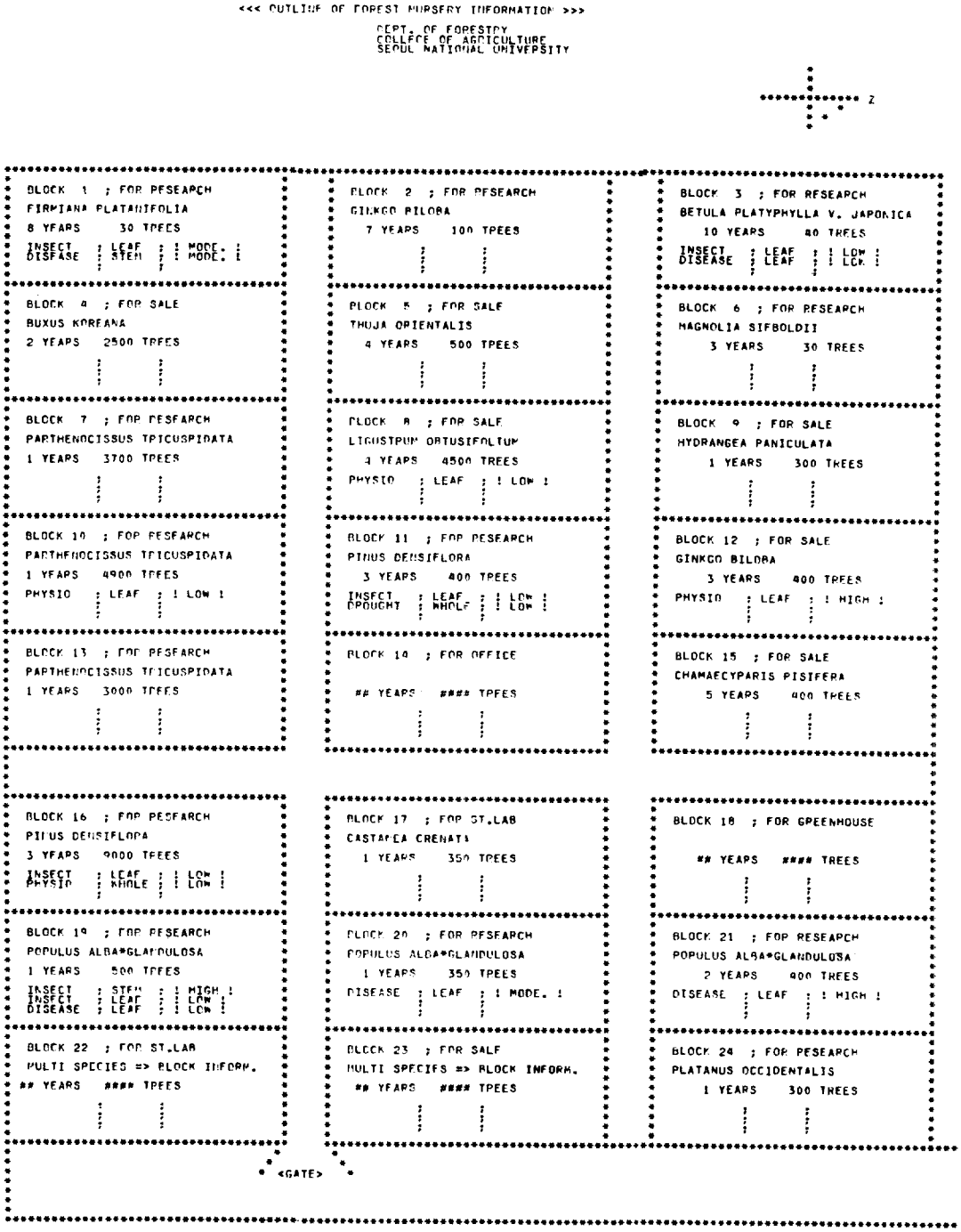
```
      SUBROUTINE OUTLINE(AAUS,AADA,AAPA,AASE)
      IMPLICIT INTEGER(A-Z)
      REAL HT,RD
      DIMENSION RL(3),US(3),AG(3),NT(3),MULT(3),ND(3),DON(6),DA(3,3),
     *PA(3,3),SE(3,3)
      CHARACTER*35 SP(3),AUS*10(3),ADA*8(3,3),APA*5(3,3),ASE*9(3,3),
     *AAUS*10(6),AADA*8(10),AAPA*5(4),AASE*9(4)
      CHARACTER*1 L1(132),L2(132)
      DATA L1/6*' ','*',35*' ','*',5*' ','*',35*' ','*',5*' ',
     ='*',35*' ','*',5*' '/
      DATA L2/6*' ',37*'*',5*' ',37*'*',5*' ',37*'*',5*' '/
      WRITE(6,201)
      DO 81 L=1,8
      DO 91 K=1,3
      READ(5,*)RL(K),US(K),MULT(K),ND(K)
      DO 21 J=1,6
      IF(US(K).EQ.J) AUS(K)=AAUS(J)
   21 CONTINUE
   80 SP(K)='
      AG(K)=10000
      NT(K)=10000
      DO 90 I=1,3
      ADA(K,I)='
      APA(K,I)='
   90 ASE(K,I)='
      IF(US(K).GE.4) GO TO 91
   54 DO 11 MUL=1,MULT(K)
      READ(5,102) SP(K)
      READ(5,*) AG(K),HT,DD,NT(K),RE,(DON(II),II=1,6)
      IF(ND(K).EQ.0) GO TO 11
      READ(5,*) ((DA(K,I),PA(K,I),SE(K,I)),I=1,ND(K))
      IF(MULT(K).GE.2) GO TO 11
      DO 41 I=1,ND(K)
      DO 51 J=1,10
      IF(DA(K,I).EQ.J) ADA(K,I)=AADA(J)
   51 CONTINUE
      DO 61 J=1,4
      IF(PA(K,I).EQ.J) APA(K,I)=AAPA(J)
      IF(SE(K,I).EQ.J) ASE(K,I)=AASE(J)
   61 CONTINUE
   41 CONTINUE
   11 CONTINUE
      IF(MULT(K).GE.2) GO TO 30
      GO TO 91
   30 SP(K)='MULTI SPECIES => BLOCK INFORM.
      AG(K)=10000
      NT(K)=10000
   91 CONTINUE
      IF(L.NE.6) GO TO 401
      WRITE(6,210)L2
  401 WRITE(6,202)L1,L1,((RL(K),AUS(K)),K=1,3),L1,L1,(SP(K),K=1,3)
      WRITE(6,203) L1,L1,((AG(K),NT(K)),K=1,3)
      WRITE(6,204)L1,((L1,((ADA(K,I),APA(K,I),ASE(K,I)),K=1,3)),I=1,3),
     *L1,L2
   81 CONTINUE
      WRITE(6,205)
  201 FORMAT(1H1,36X,'<<< OUTLINE OF FOREST NURSERY INFORMATION >>>'//,
```

PAGE 0004 OUTLINE

```
     A          55X, 'DEPT. OF FORESTRY'/
     A         55X,'COLLEGE OF AGRICULTURE'/
     A         55X,'SEOUL NATIONAL UNIVERSITY'//,3(110X,'*'/),
     A104X,13'*',' Z'/110X,'*    *'/110X,'* *'/110X,'**',4/,7X,121'*')
  102 FORMAT(A35)
  210 FORMAT(4(7X,'*',119X,'*'/),1X,132A1)
  202 FORMAT(1X,132A1,/1X,132A1,/1H+,9X,'BLOCK',I3,2X,': FOP ',A10,
     *2(16X,'BLOCK',I3,2X,': FOP ',A10)/2(1X,132A1,/),1H+,2X,3(7X,A35))
  203 FORMAT(1X,132A1,/1X,132A1,/1H+,8X,I2,' YEARS',3X,I4,' TREES',
     *2(23X,I2,' YEARS',3X,I4,' TREES'))
  204 FORMAT(1X,132A1,/3(1X,132A1/1H+,9X,A8,' ; ',A5,' ; ',A9,2(14X,
     *A8,' ; ',A5,' ; ',A9)/),1X,132A1,/1X,132A1)
  205 FORMAT(1H+,55X,5*'*T128,A1*'/T8,'*',T43,'*',7X,'*'/T8,'*',T42,
     *'*',9X,'*'/T8,'*',T41,'*  <GATES    &',A(/T8,'*')/7X,124'*')
      RETURN
      END
```

PROGRAM UNIT OUTLINE COMPILED

APPENDIX B. AN OUTPUT OF FOREST NURSERY INFORMATION



```
          <<< BLOCK INFORMATION >>>

 BLOCK NO. :  1 ; FOR RESEARCH

 SPECIES : FIRMIANA PLATANIFOLIA
 AGE; 8   HEIGHT;10.50M   BASAL DIAMETER; 9.80CM        30 TREES.
 REPRODUCTION METHOD : SEEDING

 < CULTURAL TREATMENTS >
    FERTILIZATION
        0
    IRRIGATION
        0
    WEEDING
        1
    FUMIGATION
        0
    SHADING
        0
    MULCHING
        0
    PESTICIDE
        0

 < DAMAGE CONDITION >
   INSECT
     LEAF ; ! MODE. !
   DISEASE
     STEM ; ! MODE. !


          <<< BLOCK INFORMATION >>>

BLOCK NO. : 24 ; FOR RESEARCH

SPECIES : PLATANUS OCCIDENTALIS
AGE; 1   HEIGHT;  .60M   BASAL DIAMETER;  .50CM       300 TREES.
REPRODUCTION METHOD : SEEDING

< CULTURAL TREATMENTS >
   FERTILIZATION
       0
   IRRIGATION
       0
   WEEDING
       1
   FUMIGATION
       0
   SHADING
       1
   MULCHING
       0
   PESTICIDE
       2

                $ REPORT DATE ; 1983. 7. 5
                $ REPORTER ;  JOONHWAN SHIN


   ****** CPU TIME = 21.03 SECONDS ******
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