Hkkjrh; df"k vuqla/kku if=dk] 36(1): 18-24 DOI: 10.18805/BKAP260

Hkkjrh; fry ¼flllee bfMde ,y-½ dk fV'; fo'k"k VkIfØIVke çkQkbfyx ,o tfud jhtu ekdj dh [kkt

lkfjdk tk;loky] #de ,l- rkej[1] dkey okndy[1] mek] ehu pkiMk] fo'kk ,e- jkBkM[1] ,e- oh- ijkf[k;k[1] ,e-,- bdcky] vfuy jk;] fnu'k dekj

—f"k tolpuk dæ] Hkk—vu-i- & Hkkjrh; —f"k lkf[;dh vuqla/kku lLFkku] ub fnYyh&110 012] Hkkjr

ikIr% tuojh 2021 Lohdr% tu 2021

lkjk'k

fry ¼flllee bfMde ,y-½] 0;kid bLreky d lkFk ry] çkVhu vkj x.kdkjh ,Vhv,fDlMV dk le) lkr gA ekfyD;yj –f"Vdk.k x.k l/kkj vkj lkFk gh bl Qly dh vf/kd miyC/krk d fy, Hkh cgr dke dk gk ldrk gA oreku dk; dk mí'; ck;kdfedy ikFko ,ukfyfll vkj thukfed {k= iVfVo ekdj [kkt d lkFk fV'; fof'k"V VkIfØIVke çkQkbfyx gA ge :V] yhQ vkj ¶ykoj&cM fV';l e Øe'k% 14389] 9465 vkj 5490 Mh-b-th- fjkV djr gA :V&yhQ ¼vkj&,y½] yhQ&¶ykoj ¼,y&,Q½ vkj ¶ykoj&:V ¼,Q&vkj½ e Øe'k% 135] 113 vkj 120 lyyj eVkc,fyd ;k flXufyx ikFkot ftue ,d tl 118 ikFkot Fk] ik, x,A :V] yhQ vkj ¶ykoj VkIfØIVke e Øe'k% 218] 170 vkj 180 VkIfØI'ku QDVl dh igpku dh xbA Mh-b-th- e] vuekfur :i l ekbØkvkj,u, VkjxVl :V] yhQ vkj ¶ykoj e Øe'k% 534] 376 vkj 173 FkA tfud jhtu fjihV ,ukfyfll l 379 ,l-,l-vkj-dk irk pykA bld vfrfjä :V] yhQ vkj ¶ykoj e ofj;V ,ukfyfll }kjk Øe'k% 3371] 5439 vkj 4975 ,l-,u-ih- vkj 2257] 2403 vkj 2411 bMYl feyA oreku v/;;u fofHkUu fV';l e lpkfyr çe[k to jklk;fud ikFkot dk le>u e lgk;rk djxkA Hkfo"; d Qly l/kkj dk;Øe d fy, tfud jhtu iVfVo ekdj fMLdojh ,d egRoi.k thukfed llk/ku gk ldrk gA

'kCn dtk% Mh-b-th-] ikFkot] fllee] ry] VkIfØIVkeA

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Tissue Specific Transcriptome Profiling and Genetic Region Marker Discovery of Indian Sesame (*Sisemum indicum* L.)

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ABSTRACT

Sesame (*Sesamum indicum* L.), is rich source of oil, protein and potent antioxidants with wide applications. Molecular approach can be of great use for trait improvement as well more availability for this crop. The present work aims at tissue specific transcriptome profiling along with biochemical pathway analysis and genic region putative marker discovery. We report 14389, 9465 and 5490 DEGs in root, leaf and flower-bud tissues, respectively. 135, 113 and 120 cellular metabolic or signaling pathways having common 118 pathways were found in root-leaf (RL), leaf-flower (LF) and flower-root (FR), respectively. 218, 170 and 180 transcription factors were identified in root, leaf and flower transcriptome, respectively. Among DEGs, microRNA targets predicted were 534, 376 and 173 in

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[1]to çk|kfxdh foHkkx] tukx< —f"k fo'ofo|ky;] tukx<&362 001] xtkr] Hkkjr

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root, leaf and flower, respectively. Genic region repeat analysis revealed 379 SSR. Further variant analysis revealed 3371, 5439 and 4975 SNPs and 2257, 2403 and 2411 INDELs in root, leaf and flower, respectively. The present study will aid in understanding the major biochemical pathways operating in different tissues. Genic region putative marker discovery can be a valuable genomic resource for future crop improvement program.

Key words: DEG, Pathways, Sesame, Tel, Transcriptome.

ifjp;

fry ¼*fllee bfMde ,y*-] 2n = 26½] vkerkj ij ^fry* d :i e tkuk tkrk g tk fd fiMfy,lh Qfeyh l lcf/kr g vkj ry ¼50%½ vkj çkVhu ¼18&20%½ dk le) lkr gA ;g lcl ijkuh frygu Qly g] ftl ryk dh jkuh d :i e Hkh tkuk tkrk g] ftldh [krh yxHkx 5000&5500 lky igy gMlik dh lH;rk l gb FkhA ;g x.kdkjh ,Vhv,fDlMV dh mifLFkfr d dkj.k *vejrk d cht* d :i e Hkh tkuk tkrk gA 2014 e 10-5 fefy;u gDV;j {k= ij fry dk okf"kd mRiknu 5-46 fefy;u Vu FkkA çe[k fry mRiknd n'k Hkkjr] lMku] E;kekj] efDldk vkj phu g tk fo'o mRiknu dk 68% fgLlk g ¼FAO Statistic½A ekuo miHkkx ¼73%½ d vykok] bld ry e lkcu] d,LefVd vkj fLdud;j m|kx e 0;kid mi;ärk gA cdjh mRiknk] cM] ddht] dMh] ikLrk] lfCt;k vkj djh 0;tuk vkfn e cht dk çe[k :i l mi;kx fd;k tkrk g vkj ble vk"k/kh; x.k gkr gA [kk| ry dd efFkvkfuu] flLVhu] vkftfuu vkj fVlVkQu e le) g vkj fo'k"k :i l n/kk: i'kvk d fy, i'k vkgkj d :i e mi;kx fd;k tkrk g ¼Ram *et al*., 1990½A

gkykfd bl Qly d ij thuke vuØe dk igy l gh crk;k tk pdk g yfdu mudh ryuk d lkFk fry e vkj&,y&,Q fV';l e fV'; okbt VklfØlVke ij dkb tkudkjh ugh gA bl rjg d v/;;u fofHkUu fV';l e lpkfyr ekfyD;yj r= dk le>u d fy, mi;kxh gkx vkj ,d eY;oku thukfed llk/ku gkxA oreku v/;;u dk mí'; fV';&okbt thu vfHk0;fä vkj mudh fjyfVo vcUMUl] tojk lk;fud ikFkot ,ukfyfll] ekbØkvkj,u, VkjxVl dk iokueku vkj tfud ekdj dh [kkt d lkFk VklfØl'ku QDVl dk n'kkrh yhQ] :V vkj ¶ykoj& cM d fV';l dh VklfØlVke çkQkbfyx gA

lkexh ,o fof/k;k

MVk iuikflr] io çlLdj.k vkj vlcyh

dky fry ¼,l- *bfMde*½ fdLe] xtjkr fry 10 ¼th-Vh-10½ d VklfØlVke MVk ¼yhQ] ¶ykoj cM vkj :V fV';½ dk ,u-lh-ch-vkb- ck;kçktDV l iuiklr fd;k x;k Fkk tk lkotfud Mkeu e gA QkLVD;lh Vy ¼Babraham – FastQC½ dk mi;kx djd x.koÙkk eY;kdu d fy, yhQ] :V vkj ¶ykoj l j, lhDol jhMl dk io&llkf/kr fd;k x;k FkkA j, flxy&,M jhMl dk fVekefVd Vy ¼Bolger *et al*., 2014½ dk mi;kx djd ,MlVj lhDol] vLi"V jhMl vkj de&x.koÙkk oky lhDol dk gVkdj mPp x.koÙkk oky Li"V jhM çklr dju d fy, fQYVj fd;k x;k FkkA rhuk ueuk l x.koÙkk oky jhMl dk ,d= fd;k x;k vkj 'k,V jhMl vlcfyx çkxke fVfuVh ¼Grabherr *et al*., 2011½ dk mi;kx djr g, Dyhu jhMl dh *Mh& ukok* vlcyh dh xb FkhA ck;kdMDVj idt ¼Robinson *et al*-] 2010½ dk mi;kx fM¶jf'k;y;h ,DLçlM thu ¼Mh-b-th-½ dh igpku dju d fy, fd;k x;k FkkA

fM¶jf'k;y;h ,DLçlM thuk dh igpku

fV'; okbt thu ,DLç'ku çkQkby dh fjyfVo vcUMUl tkMhnkj ryuk }kjk fd;k x;k FkkA v/;;u d rgr fry dh lHkh fV';l l çklr jhMl dk vkj-ih-d-,e- d :i e vcUMUl ,fLVeV eku dh x.kuk dju d fy, vyx l *Mh&ukok* VkfLØlVke vlcyh e ei fd;k x;kA thu ifjek.kh dj.k fM¶jf'k;y;h ,DLçlM thuk d fy, vkj vk/kkfjr ck;kdMDVj idt Þ,tvkjß dk mi;kx fd;k x;kA QkYM pt 2 vkj ,Q-Mh-vkj- <0-05 d vko';d ekinMk dk y dj v;FkkFkrk dk de fd;k x;k FkkA

ekbØk vkj ,u ,vkj VklfØlVke QDVl dh igpku vkj ,ukV'ku

10&3 l de d b&oY; lhek d lkFk] ,u-lh-ch-vkb- u,ufjMuMV çkVhu ¼,u-vkj-½ ij CykLV 2 xk&çk [kk tk d mi;kx l :V] yhQ vkj ¶ykoj d lHkh dkfVXl dk vyx l ,ukVV fd;k x;kA thu vkUVky,th ¼th-vk-½ oxk vkj dk;kRed lo/ku d fy, vkx dk ,ukfyfll fd;k x;k FkkA d-b-th- ikFko ,ukfyfll çe[k fodklkRed vkj çtuu tfod ikFkot ¼Kanehisa *et al*-] 2004½ e

'kkfey thuk dk çdV dju d fy, fd;k x;k FkkA b&oY; 1e&3 dh lhek d lkFk lykV-Vh-,Q-Mhch- 3-0 ¼Jin *et al*-] 2014½ MVkcl ij ÇykLV fd;k x;kA ehjcl l ik/kk d lHkh ifjiDo ekbØkvkj,u, dk ih-,l-vkj-,u-,-VkjxV ocloj ¼Dai and Zhao] 2011½ dk mi;kx djd fry Mh-b-th- e mud VkjxVl dh [kkt dju d fy, mi;kx fd;k x;k FkkA

fry VkIfØIVke e ,l-,lvkj vkj ,l-,u-ih- dh igpku

,l-,l-vkj- dk ekbØkIVykbV igpku Vy ¼MISA½ dk mi;kx djr g, fd;k x;kA çkbej 3 dk mi;kx djd lhDol oky ,l-,l-vkj- d fy, çkbej tkM dk fMtkbu fd;k x;k FkkA nkuk vkj d 500 cl i;j dk p;u djd yxHkx 1000 cl i;j d ¶yfdx Mh-,u-,- lhDol dk mi;kx ,l-,l-vkj- thukVkbfix d fy, Q,joM vkj fjol ih-lh-vkj- çkbejk dk fMtkbu dju d fy, fd;k x;kA leVYl ¼Li *et al*-] 2009½ ,eikbyvi l ,l-,u-ih-fudkyk x;kA leVYl e *vcfutils* çkxke ¼Wang *et al*.] 2014½ mi;kx e crk, x, rjhd l iFkd mijkä çfØ;k }kjk fudky x, ,l,uih dk igyh ckj lhDoflx MIFk ≥ 8 vkj efix dh x.koÙkk ≥ 25 vkj U;ure 2 U;fDy;kVkbM 90 chih }kjk fQYVM fd;k x;kA *SnpEff* ¼Cingolani *et al*-] 2012½ dk mi;kx thuke e tfufVd ofj;V d {k= vkj Vkbi dk iokueku yxku d fy, fd;k x;kA *SnpEff* ofj,Vl dk ,ukVV djrk g vkj vkuof'kd fofHkUurk d dkfMx çHkko] tl fd ,l-,u-ih-] lfEeyu vkj foykiu ¼bMYl½ dk iokueku yxkrk gA

ifj.kke vkj ppk

MkVk dk io çlLdj.k vkj *Mh&ukok* vlcyh

dy 12]274]428 flxy&,M lhDol jhMl çkIr g,] ftle l :V] yhQ vkj ¶ykoj cMl Øe'k 3951431] 4572282 vkj 3750715 jhM FkA x.koÙkk fQYVfjx d ckn] dy 1197934 Li"V flxy&,M jhMl ¼3398002] 4274560 vkj 3525372 Øe'k :V] yhQ vkj ¶ykoj d jhMl½ çkIr g, ftue yxHkx 90% j, jhMl FkhA vr e jhMl dk *fVfuVh* vlcyj dk mi;kx djd 503 clivj d ,u 50 eku d lkFk yxHkx 50 ,e-ch- VkIfØIV,e vkdkj e bdëk fd;k x;k vkj vkx dh ,ukfyfll ¼rkfydk 1½ d fy, mi;kx fd;k x;kA lnHk thuke d lkFk efix V,igV dk mi;kx djd dh x;h Fkh ftle :V] yhQ vkj ¶ykoj l Øe'k QkYM dojt 9-4] 10-7 vkj 11-35 d lkFk 738394] 3165696 vkj 625089 dfVXl dk ei fd;k x;kA

fM¶jf'k;y;h ,DLçlM thuk dh igpku

fV';&okbt ,DLç'ku vkj QD'kuy ,ukV'ku dh ryuk

fV';&okbt thu ,DLç'ku dh ryuk dju d fy, fM¶jf'k;y thu ,DLç'ku çkQkby çkIr dh xb FkhA vko';d ijkehVj ¼,Q-Mh-vkj- < 0-05 vkj y,x_2 QkYM pt eku 2 l vf/kd½ d lkFk] ih&oY; < 0-05 ij geu vkj&,y] ,y&,Q vkj ,Q&vkj l 14389] 9465 vkj 5490 Mh-b-th- çkIr fd,A ,y&,Q vkj ,Q&vkj d lkFk ryuk e vi&jxyfVM thu dh l[;k vkj&,y e vf/kd FkhA dy 9919] 3790 vkj 2806 thuk dk vijxyfVM fd;k x;k vkj 4470] 5675 vkj 2684 dk Øe'k vkj&,y] ,y&,Q vkj ,Q&vkj e Mkmujxyfvm fd;k x;k ¼fp= 1] rkfydk 2½A thuke ,ukV'ku u rhu fV';l e dy 911 Mh-b-th- crk,A

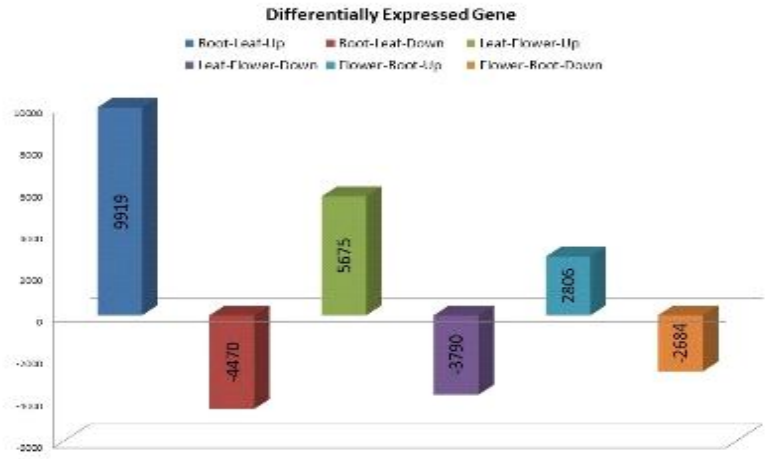
:V fV'; e] ge doy dN thuk d gh ,DLç'ku feyA mnkgj.k d fy, :V dh of) d fy, ACTIN2 dh mPp vcUMUl] lh,,lih thu dh Hkfedk çfrofnr gA thu ,lVh,p&21 dk jkxk.k çfrjk/k e Hkfedk fuHkku d fy, tkuk tkrk g] dod vkj ok;jl ih vkj 10 thu d fy, fof'k"V çfrjk/k tkfd ,fFkyhu bMîflfcy g] ,e,yih thu vkj okV&1 thu :V dh j{kk d fy, gA ck;kfVd vkj ,ck;kfVd ruko e Hkfedk j[ku okyh :V e th,,y lh yfDVu vcUMUl ,DLçlM ik;k x;k FkkA gekj MVk u

rkfydk 1% *fllee bfMde* dh vlcyh LVfVfLVDlA

Vkbi	fVfuVh ifj.kke
Ldk¶QkYMl dk VkVy lkbt	50331132
dkfVxl d ucj	113127
lcl yck dkfVx	7752
lcl NkVk dkfVx	201
ehu dkfVx lkbt	445
,u 50 dkfVx yckb	503

rkfydk 2% *Mh&ukok* vlcyh l fM¶jf'k;y;h ,DLçlM thu ¼Mh-b-th-½ dh l[;kA

l;ktu Vkbi	Mhbth dh l[;k
:V & yhQ vijxyfVM	9919
:V & yhQ Mkmujxyfvm	4470
yhQ & ¶ykoj vijxyfVM	3790
yhQ & ¶ykoj Mkmujxyfvm	5675
¶ykoj & :V vijxyfVM	2806
¶ykoj & :V Mkmujxyfvm	2684



fp= 1½ *fllee bfMde* d tM&yhQ&¶ykoj fV'kt e fM¶jf'k;y;h ,DLçlM thuA ,Dl&,fDll d Åij vkj uhp d ckj Øe'k vijxyfVM vkj Mkmujxyf VM thu fn[kkrh gA

,uvk3 viVd thu] gkb ,fQfuVh ukbVV Vkl ikVj ¼,p,Vh,l½ vkj dfY'k;e viVd thu] lykTek f>Yyh dfY'k;e&Vkl ikfVx ATPase dh vcUMUl ,DLç'ku dk :V fV'; e çdV fd;kA

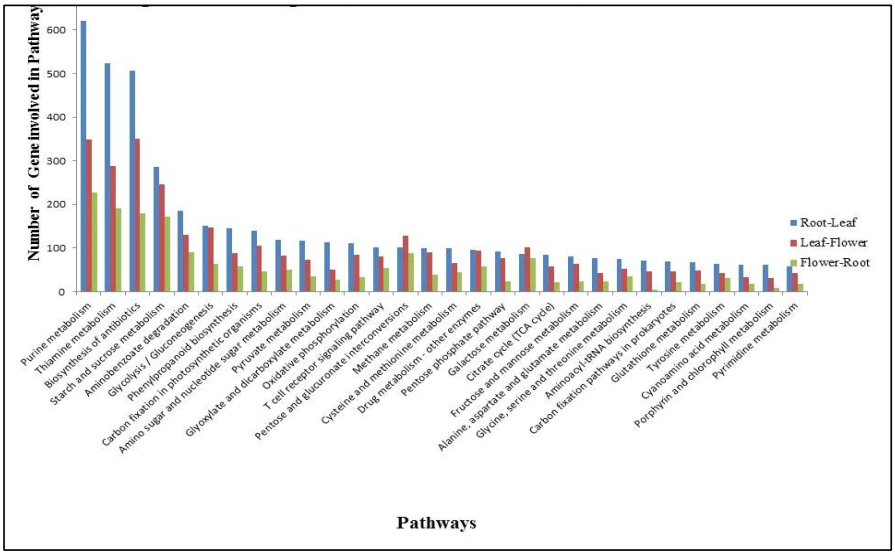
yhQ fV'; VklfLØlVke ,ukfyfll e] ge QkVkflFkfll l lcf/kr thuk dh lcl T;knk vcUMUl ,DLç'ku feyh tl fd Dykjkf Qy ckbfMx çkVhu] fXyljkfYMgkbM 3Q,LQV MhgkbMk tut] QkVkflLVe ı vkj O lc;fuV nkuk QkVkflLVe dk lrfyr dju d fy, gkr gA ge thu v,fDlu& ckbfMx çkVhu ,cih19, dh vcUMUl ,DLç'ku feyh] ftl 'kV foHknu e Hkfedk fuHkku d fy, çfrofnr fd;k tk pdk gA thu rpm1& bVjfDVx çkVhu 4 dh vcUMUl ,DLç'ku jkxk.k d fy, ik/k dh çfrj{kk çfrfØ;kvk d fy, vPNh rjg l tkuk tkrk gA thu ckDl bufgfcVj &1 dh vcUMUl ,DLç'ku dk ck;kfVd vkj ,ck;kfVd dkf'kdk eR; ;k ifÙk;k d ,iklVkfll dk vVU;Vj fjikfVM gA

¶y,oj VklfØlVkfed MVk e] geu dN io&çe[k :i l ,DlçLM thu ik,A bue Fkek&V,yjl e d,p Mkeu thu dh Hkfedk gA ;g ¶ykoj lonu'khyrk d fy, ghV LVl d fy, mEehnokj thu g tk mRikndrk dk dkQh çHkkfor djrk g ¼Guilioni *et al.*] 1997½A ch,Mh,p LVl e Xykblhu fcVkbu lp; vkj ik/k e ukbVktu vkj lYQj d fodkl e enrk d lkFk tMk gvk gA ¶ykoj fV'; e thu] vEyh; ,MklkbfVut dh mifLFkfr fofHkUu jkxtudk d lid e j{kk r= dk leFku djrh gA ijkx d vdj.k vkj/;k Vîc d fodkl e ifDVu ,LVjt thu lgk;rk djrk gA th,ihMh,p] QkVkihfj;M dh çfrfØ;k e ¶ykoj fudyu dk fu;f=r djrk gA liy e ektn ,p,Mh thu dk i"ik d fu;f=r phuh ^^ehB ldrk^^ l tMk crk;k x;k gA

ekbØkvkj,u, vkj VklfØlVke QDVl dh igpku vkj ,ukV'ku

;g ik;k x;k fd RL, LF vkj RF l 14389] 9465] 5490 dkfVx lhDol dk 135] 113 vkj 120 lyyj eVkc,fyd ;k flXufyx ikFko e oxh—r fd;k x;k FkkA dkfVx lhDol }kjk lcl vf/kd çfrfuf/kRo fd, tku oky ikFkot QVh ,flM] fyukfyd ,flM p;kip;] l;jhu p;kip;] çdk'k l'y"kd thok e dkcu fu/kkj.k] v,Dlh MfVo Q,LQkjkby'ku] ,feukctkV fofdj.k] ,Vhck;kfVd nokvk d tol'y"k.k] vehuk 'kxj vkj U;fDy;kVkbM 'kxj p;kip;] LVkp vkj lØkt d p;kip;] fFk;kehu p;kip; vkj Xykbdkykbfll /Xydkuktufll d ck;kflFkfll FkA

v/;;u d rgr fofHkUu fV';l l ikFkot dh ryuk dju ij] ;g n[kk x;k fd lHkh rhu fV';l d chp 118 ikFkot lk>k fd, x, FkA fp= 2 lHkh rhu fV';l e çe[k rhl leku ikFkot fn[kkrk gA cht fudkyu vkj fry d ry d lHkkfor ,Vhv,fDlMV x.k bld pkj çe[k ?kVdk ;Fkk fyxUl] llkfeu] lLekfyuky vkj llkfeuky d dkj.k gkr g] tk fd Qfuyçkiukb M ikFko }kjk l'yf"kr gkr g ¼Kato *et al*-] 1998½A



fp= 2% : V&yhQ] yhQ&¶ykoj vkj ¶ykoj&:V fV'; e 'kh"k 30 leku ikFkotA

vkj] ,y] ,Q fV';l d chp fof'k"V Vh,Q Øe'kh 120] 89 vkj 64 FkA fry e dN Vh,Q d vkfFkd :i l egRoi.k y{k.kk d lkFk tM gku dh lpuk g] mnkgj.k d fy,] lc,p,y,p VklfØl'ku QDVl tMk g vkfyd ,flM vkj fyukfyd ,flM dVV d lkFk ¼Kim *et al*-] 2007½, *ih2/* bvkj,Q Qfeyh tMh gb g tfod vkj vtfod LVl çfrfØ;kvk d lkFk] LVl çfrfØ;kvk VklfØl'ku QDVl dk tyHkjko d lkFkA ,e,Mh,l& c,Dl VklfØl'ku QDVl dk fry d ¶ykoj vkj cht fodkl l tMk gA lphc) Vh,Q thu dk Hkfo"; d ,l,uih [kkt vkj blh rjg d ,lkfl,'ku v/;;u d fy, yf{kr fd;k tk ldrk gA

dkfVx e MflydV dk gVku d ckn] geu Øe'kh :V] yhQ vkj ¶ykoj e 534] 376] 173 ekbØkvkj,u, d y{; dh Hkfo";ok.kh djr g, 130] 169 vkj 132 Mhbth çklr fd,A ; ekbØkvkj,u, efMdxk VdVyk] ikiyl Vkbdkdkik] vkfjtk lfVok] vjfcMkflll Fkkfy;kuk vkj vjfcMkflll fyjkVk d lkFk vf/kdre lekurk j[kr FkA vkx d vuqla/kku / lR;kiu d fy, ekbØkvkj,u, dk lphc) djuk Hkfo"; dk thukfed llk/ku gk ldrk gA gekj lphc) ,evkbvkj,u, dk mi;kx Hkfo"; d Qly l/kkj dk;Øe ¼Auer and Frederick] 2009½ d fy, mud lcf/kr ckbfMx lkbV ij i,yhekfQte dh [kkt d fy, fd;k tk ldrk g] tl fd pkoy vkj Q,Dlfeyy VA dy 147 ¼66 ck;kykftdy çklflll] 62 ekfyD;yj QD'kul ,M 19 lY;yj dkEikuVl½ thvk Vel vkj,y dk vlkbu fd, x,] 133 ¼57 ck;kykftdy çklflll] 59 ekfyD;yj QD'kul ,M 17 lY;yj dkEikuVl½ ,y,Q d fy, vkj 130 ¼56 ck;kykftdy çklflll] 55 ekfyD;yj QD'kul ,M 19 lY;yj dkEikuVl½ ,Qvkj d fy,A :V] yhQ vkj ¶ykoj pj.kk d chp dy 120 thvk VEl ik, x,A

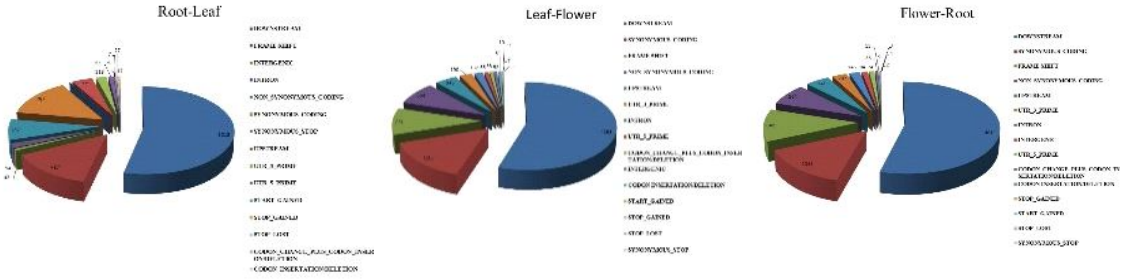
fry VklfØlVke e ,l-,l-vkj- vkj ,l-,u-ih- dh igpku

2563 ,l,lvkj oky dy 16236 lhDol dh igpku dh xb] ftle 1138 lhDol e ,d l vf/kd ,l-,l-vkj- FkA Mkb U;fDy;kVkbM ¼47-56%½] VVk U;fDy;kVkbM ¼1-20%½] gDlk U;fDy;kVkbM ¼0-27%½ vkj iVk U;fDy;kVkbM ¼0-11%½ fjihVl ;fuVl d ckn Vkb U;fDy;kVkbM ekVh¶l dh l[;k lcl vf/kd ¼50-83%½ ikb xbA VMe fjihVl dh fofHkUu l[;kvk d lkFk b,lVh&,l,lvkj dh vkofÙk;k dh x.kuk dh xb vkj ble fn[kk;k x;k g fd 6 VMe fjihVl ¼34-33%½ d lkFk ,l,lvkj lcl T;knk d,eu Fk] mld ckn 5 VMe fjihVl ¼33-55%½] 7 VMe fjihVl ¼15-84%½] 8 VMe fjihVl ¼9-520%½] 9 fjihVl ½2-965%½] 10 fjihVl ½2-028%½] 11 fjihVl ¼1-52%½] 12 fjihVl ¼0-19%½ and 15 VMe fjihVl ¼0-039%½ ¼rkfydk 3½-

fry d ,l-,l-vkj- ekdjk dk mi;kx MkbofIVh ,ukfyfll vkj i,l;y'ku LVDpj] Hkkxkfyd mRifÙk dk irk yxku d fy, vkj ojkbVy fMÝf'k,'ku d fy, fd;k x;k gA bu xj&dkfMx {k= ,l-,l-vkj- d vyok] dkfMx {k= ,l,lvkj dk Hkh fry e fjikV fd;k tkrk g] tl b,lVh&,l-,l-vkj ¼Gebremichael and Parzies, 2011½

rkfydk 3% *fllee bfMde* e fofHkUu ekfVQ VkbIl l ,l-,l-vkj- dh l[;kA

		fjihVl l[;k											
ekfVQ Vkbi	,l-,l-vkj- dh l[;k	5	6	7	8	9	10	11	12	13	14	15	%
Mkb	1219		551	286	209	76	52	39	5			1	47-56
Vkb	1303	832	318	119	34								50-84
VVk	31	22	9										1-21
iVk	3	1	2										0-12
gDlk	7	5		1	1								0-27
VkVy	2563	860	880	406	244	76	52	39	5			1	
%		33-55	34-33	15-84	9-52	2-97	2-03	1-52	0-19			0-04	



3(A) 3(B) 3(C)

fp= 3% :V&yhQ ¼3,½] yhQ&¶ykoj ¼3ch½ vkj ¶ykoj&:V ¼3lh½ fry d fV';l e ij vkvkj,Q ij ,l-,u-ih- dk forj.kA

rkfydk 4% *fllee bfMde* e ,l-,u-ih/bMYl dk lkjA

fV';	,l-,u-ih-	bMy	VkVy
:V	3371	2257	5628
yhQ	5439	2403	7802
¶ykoj	4975	2411	7386

vkj vkj,u, ld vk/kkfjr tfud ,l-,l-vkj ¼Zhang *et al*.] 2012½A VklfØlVkfed –f'Vdk.k dk mi;kx djr g,] fry l 7450 ,l,uih vkj 362 bMy dk fjikV fd;k x;kA ,l-,l-vkj- dk mi;kx fry e ,e-,-,l- e cgr lQyrkiod fd;k x;k g] tl fd cht dk ry vkj bldh çkVhu dVV ¼Li *et al*-] 2014½A vLQVu'khy dlly x.k] fuf'pr of) LoHkko vkj cht vkoj.k dk jx ¼Uzun *et al*-] 2003½A vko';d ikbi ykbu dk mi;kx djr g,] geu Øe'kh 5628] 7802 vkj 7386 dy ofj,Vl dh igpku dh] ftue 3371] 5439 vkj 4975 flxy U;fDy;kVkbM i,yhe,fQTel ¼,l-,u-ih-½ vkj 2257] 2403 vkj 2411 bMYl :V] yhQ vkj ¶ykoj e gA vf/kdre bMYl yhQ ¼51½ e ik, x,] mld ckn :V ¼17½ vkj ¶ykoj ¼15½ e ik, x, ¼rkfydk 4½] fp= 3 ¼,½] ¼ch½ vkj ¼lh½A

fu"d"k

geu thu ,Dlç'ku dh fjyfVo vcUMUl d lkFk fry e vkj&,y&,Q fV';l d fV'; okbt VklfØlVke dh fjikV fd;k gA ge 14389] 9465 vkj 5490 Mh-b-th- dh fjikV djr g] ftue l 9919] 3790 vkj 2806 thuk dk vijxyfVM fd;k x;k vkj Øe'kh 4470] 5675 vkj 2684 dk vkj,y,Q e Mkmujxyfvm fd;k x;kA geu Øe'kh vkj&,y] ,y&,Q] ,Q&vkj e lkekU; 118 ikFkot oky 135] 113 vkj 120 lyyj p;kip; ;k flXufyx ikFkot ik,A :V] yhQ vkj ¶ykoj VklfØlVke e igpku x, VklfØl'ku QDVl Øe'kh 218] 170 vkj 180 FkA Mh-b-th- e] vuekfur :i l ekbØkvkj,u, VkjxVl 534] 376 vkj 173 Øe'kh :V] yhQ vkj ¶ykoj e FkA tfud jhtu fjihV ,ukfyfll l 379 ,l-,l-vkj- feyA bld vfrfjä ofj;V ,ukfyfll e Øe'kh 3371] 5439 vkj 4975 ,l-,u-ih- vkj 2257] 2403 vkj 2411 bMYl dk :V] yhQ vkj ¶ykoj e çdV fd;k x;kA bl rjg d v/;;u fofHkUu fV';l e dke dj jg ekfyD;yj çfØ;k dk le>u d fy, mi;kxh gkx vkj ;g ,d eY;oku thukfed l lk/ku gkxk ftle iVfVo ,l-,l-vkj- vkj ,l-,u-ih- gkx tk Hkfo"; e mi;kx fd, tk ldr gA

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