

H[SRVHG OLJQLQ XQLWV 7KXV LW LV
PROHFXOHV WKDW GHWHUPLQH WKH SU
0HFKDQLVWLFDOO\ WKLV JUDIWLQJ FD
UHDFWLRQ RU D QXFOHRSKLOLF DGGLV
FRQGXFWHG ERWK LQ WKH SUHVHGHF
VPDOO PROHFXOHV WKDW ZKHQ%RFRVGHQ
RWKHU VXEVWUDWHV
YDULHW\ RI SKHQROLF FRPSRXQGV H

6KRUW &RPPXQLFDWLRQ 2SHQ \$RPHG

9DOXH \$GGHG %LRPDWHULDOV YL4~OL44HGHWL\ 4dWHO\OLHUHORSH
WKL DFRXQW RI SUHVHUYDWLYHV WKH

0DUN ' &DQQDWBODUWKXU - 5DJDXVNDV
6FKRRO RI &KHPLVWU\ %LRFKHPLVWU\ 5HQHZDEOH YL4~OL44HGHWL\ 4dWHO\OLHUHORSH
'HSDUWPHQW RI &KHPLFDO %LRPROHFXODU (QJLQHULQJ 'HSDUWPHQW RI)RUHVWU\ :LOGOLIH)LVKH
&RUUHVSRRGLQJ DXWKRU \$UWKXU - 5DJDXVNDV 'HSDUWPHQW RI &KHPLFDO %LRPROHFXODU (QJLQH
7HQHVVHH .QR[YLOOH 71 86\$ (PDLO \$UW 5DJDXVNDV DQNDSSQLFDWLRQV XZKHUH ZDWHUSURRI
5HFHLYHG -DQXDU\ \$FFHSXHG \$5000 PDWHULDOV DUH UHTXLHG 7KXV FRQ
&RSULJKW 5DJDXVNDV \$- HW DO 7KLV LV DQ RSHQDFFHV DFWLRQGLWULEXWHG XQGHU WKH R-
XQHVWULFWHG XVH GLWULEXWLRQ DQG UHSURGXFWLRQ LQ DQ\ PHGLXP SURYLGHG WKH RULJLQDO D
6KRUW &RPPXQLFDWLRQ

\$V ZH GHQYH GHSHU LQWR WKH VW FHQWXU\ FRQFHUQV UHJDUGLQJ WKH
FXUUHQW VWDWH RI WKH HQYLURQPHQW DQG WKH IXWXUH RI WKH SODQHW FRQW
WR ULVH ,Q UHVSRQVH FRPSDQLHV DQG RUJDQL]DWLRQV IURP D EURDG
VSHFWXP RI LQGXVWULHV DUH LQFUHDVLQJ WKHLU LQYROYHPHQW LQ MRLQLQJ
ZRUOGZLGH HIIRUW WR LQFRUSRUDWH VXVWDLQDELOLW\ LQWR H[LVWLQJ RSHUDW

ZRRG\ DQG SODQW ELRPDVV ZKLFK FRPSULVH RI WKUHH PDLQ ELRSRO\PHUV
FHOOXORVH KHPLFHOOXORVH DQG OLJQLQ :KLOVW FHOOXORVH KDV PDQ\ X
SDSHU SURGXFWV DQG FRQYHUVLRQ WR HWKDQRO WR QDPH D FRXSOH WK
H
H
DTXHRXV V\WHP

/DFFDVHV EHQ]HQHGLRO R[\JHQ R[LGRUHGXFWDVH (& DUH D
FODVV RI PXOWLFRSSHU R[LGDVHV WKDW DUH IRXQG LQ D YDULHW\ RI IXQJ
EDFWHULG SODQW DOJDH DQG LQVHFW > @ 7KH\ FDWDO]H WKH IRXU HO
UHGXFWLRQ RI 2 WR WZR + 2 FRXSOHG WR WKH R[LGDWLRQ RI IRXU VXEVWUDV
PROHFXOHV PDLQJ WKHP D fJUHHQg FDWDO\WV RI FKRLFH IRU D YDULHW\ F
R[LGDWLYH SURFHVVHV UDQJLQJ IURP SXOS GHOLJQLILFDWLRQ WR WKH V\QW
RI ILQH FKHPLFDOV *LYHQ WKDW OLJQLQ LV D QDWXUDO ODFFDVH VXEVWUDW
ORJLFDQ WKDW WKHVH HQ]\PHV KDYH EHHQ LQFUHDVLQJ\ HPSOR\HG LQ WKH
WZR GHFDGHV WR IXQFWLRQDOL]H OLJQRFHOOXORVLF ILEHUV > @ 7KH QR
ELRPDWHULDOV FUHDWHG H[KLELW LPSURYHG DQWLPLFURELDO K\GURSKREL
DQG VWUHQQJK SURSHUWLHV

6XUIDFH IXQFWLRQDOL]DWLRQ FDQ EH DFKLHYHG LQ D QXPEHU RI ZD\V
RQH RI ZKLFK LV E\ FRYDOHQWO\ OLQNLQJ VPDOO PROHFXOHV RQWR WKH VXU

&LWDW&DQ QDWHOOL 0' 5DJDXVNDV \$-
%LRPDWHUGRL ;

9DOXH \$GGHG %LRPDWHULDOV YLD /DFFDVH OHG

3DJH RI

H[WHQGHG WLPH SHULRG)RU H[DPSOH 5DUXVNDG HENKDR *ZQ%UGD VCH WNDQ GUD 5
K\GURSKRELF\ RI EHHFK YHQHHUV ODFFDVHV ZRUH HPSOR\ HGSURFLQJ DQW QLO
IOXRURSKHQROV RQWR WKH VXUIDFH RI WKH YHQHHUV > @ 7KH LQFUHDVHG
K\GURSKRELF\ LV LPSRUWDQW IRU SURYLGH\ LQGLFHQ3 WDPDFWLRQ ZRRP \$URP
ZHDWKHULQJ DQG ELRGHJUDGDWLRQ \$ FRPHRQ LGURSKRELF\ QJDFWHU QD LV XQJDO
ODXU\O JDOODWH 'XH WR LWV ORQJ DONO VLGH FKDLQ LW KDV EHHQ XVHG L
FRQMXQFWLRQ ZLWK ODFFDVHV WR IXQFWLRQDOPDFLHW\ XHELWJ ORF\%XUWR
ILEHUV *DUFLD 8EDVDUW HW DO GHPRQV\UHLZH QJWKD WLFUKEV\HFKQRORJ\ FRX
EH XVHG RQ KDUGZRRG NUDIW SXOS WR HGHXFH ZDWHU SHOHWUDWLRQ DQG /D
ZHWWDELOLW\ RI WKH UHVXOWLQJ KDQGV\KDFWLRQ @LJDLWRQ RPDQJRWKHU\ V\XGLXV
WKH SURFHVV RQ MXWH ILEHUV WR GHY\QJ DQGDWHU LQ DQFKW 2ZDQGRUH
FRPSDWLEOH ZLWK K\GURSKRELF UHVLQV DQGDQFRXQGDW KHUHQW\ HEH\NDVH QD WK
UHLQIRUFH PHQW LQ FRPSRVLWHV > @ 7KH SURFWHFWLRQ RQ ZRRP QDFURQ VMFKG
PLFURELDO DQG IXQJDO DFWLYLW\ KDV DQFRUH HQDQGDG YDQFHQGEJ HPSXHELVQJ *DQ.F
LQQRWDWLYH ODFFDVH FDWDO\JHG LRGLQ DFWLRQ RIRWKHJZRRRQGXO@VRE \$KHQKORLQ F
> @ /DFFDVH FDWDO\JHG JHQHUDWLRQ RI LRGR SKHQROLV VXFK DV
LRGRYDQLOOLQ DQG LRGR HWK\O YDQLOOLQV H\KHLWDEHHQDQKLRZQ +WROURP &RV
VXEVDQWLDO JURZWK LQKLELWRU\ HHHF WQRQLDQY H\HDFV ZRRRGRONSKHQRLOJ FXQH
VSHFLHV DQG ILOWHUV - 9LURO OHWKRGV

6WUHQJWK SURSHUWLHV VXFK DV ZHW DQGDG\ H\HDFV V\HDFV W\H\HDFV W\H\HDFV
EXUVW DUH RI JUHDW LPSRUWDQFH LQ WKH JRRG H\HDFV W\H\HDFV W\H\HDFV
7KHVH VWULQJHQW SURSHU\ VWDQGDUG YDQLOOLQV W\H\HDFV W\H\HDFV W\H\HDFV
DQG SDFNDJLQJ SURGXFWV PHHW WKH TXDOLW\ QHHGV RZ SURFHQ XDSISGLFDWLRQ
3UH\LRXV UHVHDFK ZLWKLQ RXU JURXS XDV\ JRRGHG HWKQW DFFHSVR E\ VSKHWR
JUDIWLQJ RI DPLQR DFLGV RQWR WKH VXUIDFH RI KLJK OLJQLQ FRQWHQW
VRIWZRRG NUDIW SXOS FDQ \LHOG KDQGV\KDFWLRQ <X & 3HL - =KDQJ) DQDQ
WHQVLOH VWUHQJWK DV ZHOO DV LPSURYHG W\H\HDFV UH\HDFV W\H\HDFV W\H\HDFV
WKDW WKH LQFUHDVH LQ VWUHQJWK SURSHU\ HGHXFH W\H\HDFV W\H\HDFV W\H\HDFV
DQLRQLF FKDUJ RI WKH ILEHUV LQWURG\HGHXFLWR DO LQFUHDVH
WKH DPLQR DFLGV JUDIWHG RQWR WKH ILEHUV W\H\HDFV W\H\HDFV W\H\HDFV
WKHVH VWUHQJWK SURSHUWLHV ZHUH DOVR HGHXFH W\H\HDFV W\H\HDFV W\H\HDFV
JDOOLF DFLG RQWR WKH VXUIDFH RI D VLP\HDFV W\H\HDFV W\H\HDFV W\H\HDFV

7KH ILHOG RI OLJQRFHOOXORVLF ILEHU DEWLYLFDWLRQ W\H\HDFV W\H\HDFV W\H\HDFV
ELRPDWHULDOV KDV QRW RQO\ SURYLGHG DQDQGDG W\H\HDFV W\H\HDFV W\H\HDFV
OLJQLQ ZKLOH IXUWKHU HVWDEOLVKLQJ WKH ELRUHILQHU EXW KDV DOVR
HQJLQH HUHGH VPRH WUXO\ UHPDUNDEOH PDWHULDOV ZLWK ZLGHV SUHDDG SURFWLF
DSSOLFDFWLRQV &RPELQH ZLWK WKH XVH LQJDOQDFRQW\H\HDFV W\H\HDFV W\H\HDFV
WKLV ELRWHFKQRORJLFDQ DSSURDFK LV SURSDWLEOH DQGDG W\H\HDFV W\H\HDFV W\H\HDFV
VFLHQWLILF HIIRUW > @)XUWKHUPRUH W\H\HDFV W\H\HDFV W\H\HDFV W\H\HDFV
QRW RQO\ OLPLWHG WR OLJQRFHOOXORVLF ELRPDWHULDOV LXDQDQ\ DQDQGDG W\H\HDFV W\H\HDFV
IXQFWLRQDOPDFLHW\ FKLWRVDQ > @ 7KXV LW\ZLQO\FHQDQW\H\HDFV W\H\HDFV W\H\HDFV
(HDFV DQDQGDG QRW RQO\ WKH W\SHV RI QRXV DQDQGDG W\H\HDFV W\H\HDFV W\H\HDFV
IURP OLJQRFHOOXORVLF ELRPDWHULDOV EXW DQDQGDG W\H\HDFV W\H\HDFV W\H\HDFV
FDQ EH PRGLHG DQG WKH FRUHVSRQGLQJ HZQHQ\ PDWHULDOV W\H\HDFV W\H\HDFV W\H\HDFV
JHQHUDWHG <X & 3HL - =KDQJ) +HWHURJHQHRXV
V\ULQJDOGHK\GH RQWR FKLWRVDQ E\ ODFF

5HIHUHQFH

5DJDXVNDV LQGLFHQ3 WDPDFWLRQ ZRRP \$URP
7KH SDWK IRUZDUG IRU ELRIXHOV DQG ELRPDWHULDOV 6FLHQFH